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FRACTURES OF THE TEMPORAL BONE

GEORGE KELEMEN, M.D.

BOSTON

The following eighty photomicrographs were taken in 18 cases of death due to fracture of the skull involving the temporal bone. The trauma was that occurring in ordinary life, caused by fast moving vehicles, falls from various heights, and so on. The patients were between 17 and 50 years of age, both sexes being represented. For comparison photomicrographs taken in cases of craniotomy for delivery are included. The pictures, dealing exclusively with human material, demonstrate the variations of temporal fractures with their effects on the different component tissues of the external, the middle and the internal ear.

Sections were cut, after the usual fixation, decalcification and embedding, chiefly in the horizontal plane with the exception of a small group which were cut vertically. All were stained with hematoxylin-eosin. The plane of the section is indicated by the letter following the serial number: H for horizontal; V for vertical.

Though in many of the sections all three main cavities of the hearing organ, the external, the middle and the internal ear, are represented, the series is arranged starting with the external and ending with the internal ear, according to the most outstanding change in the elements of the temporal bone.

This collection is a reproduction of a part of a scientific exhibit on display at the meeting of the American Academy of Ophthalmology and Otolaryngology in Chicago, Oct. 10 to 13, 1943, and at the meeting of the New England Otolaryngological Society in Boston, Nov. 17, 1943. Except for a few general data, no detailed description is given here; most of the cases I have discussed in previous publications dealing with injuries of the hearing organ.[1] Twenty-one of the pictures were reproduced in one or more of these communications, while 59 are published here for the first time.

The 18 patients and the injuries which they incurred are listed here, with the photomicrographs taken in each case:

Figures 1, 2 and 51: Woman 45 years of age. Run over by a street car. Death one-half hour after the accident.

Figures 3, 21, 28, 41 and 57: Man of unknown age. Run over by a street car. Immediate death.

Figures 4, 5, 11, 29, 43 and 78: Man of unknown age. Struck on the head when a brick fell from the third floor. Date of death unknown.

Figures 6, 7 and 61: Man 49 years of age. Injured by a fall from the step of a moving street car. Death a few hours after the accident.

Figures 8, 26, 58, 63 and 73: Man 35 years of age. Injured by a fall from a height. Death one and a half hours after the accident.

Figures 9, 20, 38, 48, 49 and 70: Woman of unknown age. Run over by an automobile. Date of death unknown.

Figures 10, 12, 13, 52, 56, 62, 64, 65, 68 and 69: Man 33 years of age. Run over by an automobile. Death forty-eight hours after the accident.

Figures 14, 32 and 33: Man 59 years of age. Run over by an automobile. Immediate death.

Figures 15, 31, 34, 35, 46, 59 and 75: Man 18 years of age. Injured in an accident, the nature of which is unknown. Death forty-eight hours after the accident.

Figures 16, 17 and 80: Man 23 years of age. Injured when he ran against a wall, riding a bicycle. Immediate death. This case has been reported in detail.[1f]

Figures 18, 19 and 74: Man 58 years of age. Run over by a train. Immediate death.

Figures 22, 23, 27, 30, 45, 50, 76 and 77: Woman 17 years of age. Injured by a fall from a ladder. Death twenty days after the accident. This case has been reported in detail.[1k]

Figures 24, 72 and 79: Man 57 years of age. Struck by a tramway car. Death four days after the accident. This case has been reported in detail.[1l]

From the Massachusetts Eye and Ear Infirmary.

This project was aided by a grant from the Charlton Fund, Tufts College Medical School.

1. (*a*) Kelemen, G.: Commotio labyrinthi nach Schussverletzungen, Neurol. Centralbl. **35**:957-959, 1916; (*b*) Commotio labyrinthi nach Blitzschlag, ibid. **35**:959-960, 1916; (*c*) Zur Pathologie der Hammer-Ambossverbindung, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **124**:254-275, 1930; (*d*) Fracture of Skull and Hearing Organ, Országos Mentőügyi Közlöny **1**:5-10, 1930; (*e*) Ueber die Fissuren im knöchernen Innenohr, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **137**:36-49, 1933; (*f*) Traumatische Cholesteatomgenese, Acta oto-laryng. **20**: 211-230, 1934; (*g*) Topographical Contributions to the Pathology of Neuritis Acustica, ibid. **21**:134-148, 1934; (*h*) Die Widerstandsfähigkeit des Neugeborenenfelsenbeines gegenüber Traumen, Monatschr. f. Ohrenh. **69**: 1496-1509, 1935; (*i*) Fracture of Base of Skull and Otosclerosis, Laryngoscope **46**:252-261, 1936; (*j*) in Discussion on Disturbances of Function of the Ear Following Injury, Proc. Roy. Soc. Med. **29**:1114-1126, 1936. (*k*) Liebermann, T., and Kelemen, G.: Double Injury to the Ear, J. Laryng. & Otol. **54**:379-384, 1939. (*l*) Kelemen, G.: Propagations of Inflammatory Processes Between Petrous Bone and Endocranium of "Frustrated" Form, Ann. Otol., Rhin. & Laryng. **48**: 375-391, 1939.

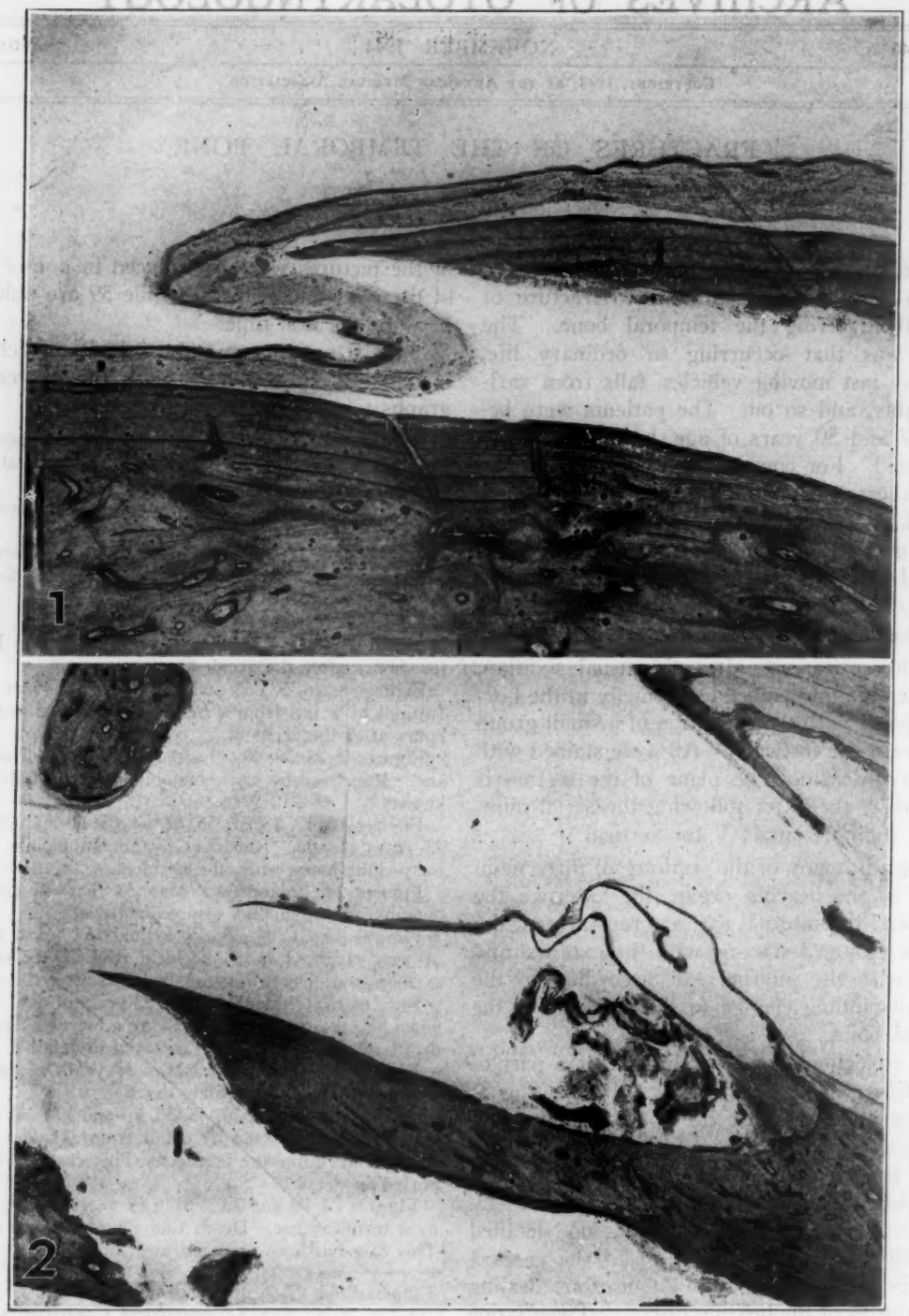

Fig. 1 (H).—Fracture of the external auditory canal. Fragment (*1*) showing the steplike appearance of the canal in otoscopic examination.

Fig. 2 (H).—Fracture (*1*) of the anterior wall of the external auditory canal. The tympanic membrane is ruptured and its layers torn apart.

Figures 25 and 47: Man 58 years of age. Injured in an accident, the nature of which is unknown. Time of death unknown.

Figures 40, 42 and 53: Man 20 years of age. Run over by a street car. Immediate death.

Figures 36, 37, 39, 44, 54, 60, 66, 67 and 71: Three infants on whom craniotomy was performed for delivery. These cases have been reported in detail.[1h]

Assistance in this work was given by Miss Muriel P. McLatchie, director of the school of medical illustration of the Massachusetts General Hospital, and by Lieutenant (1st gr.) Wilbour Chase Lown, chief of the photographic department of the same hospital.

414 Beacon Street.

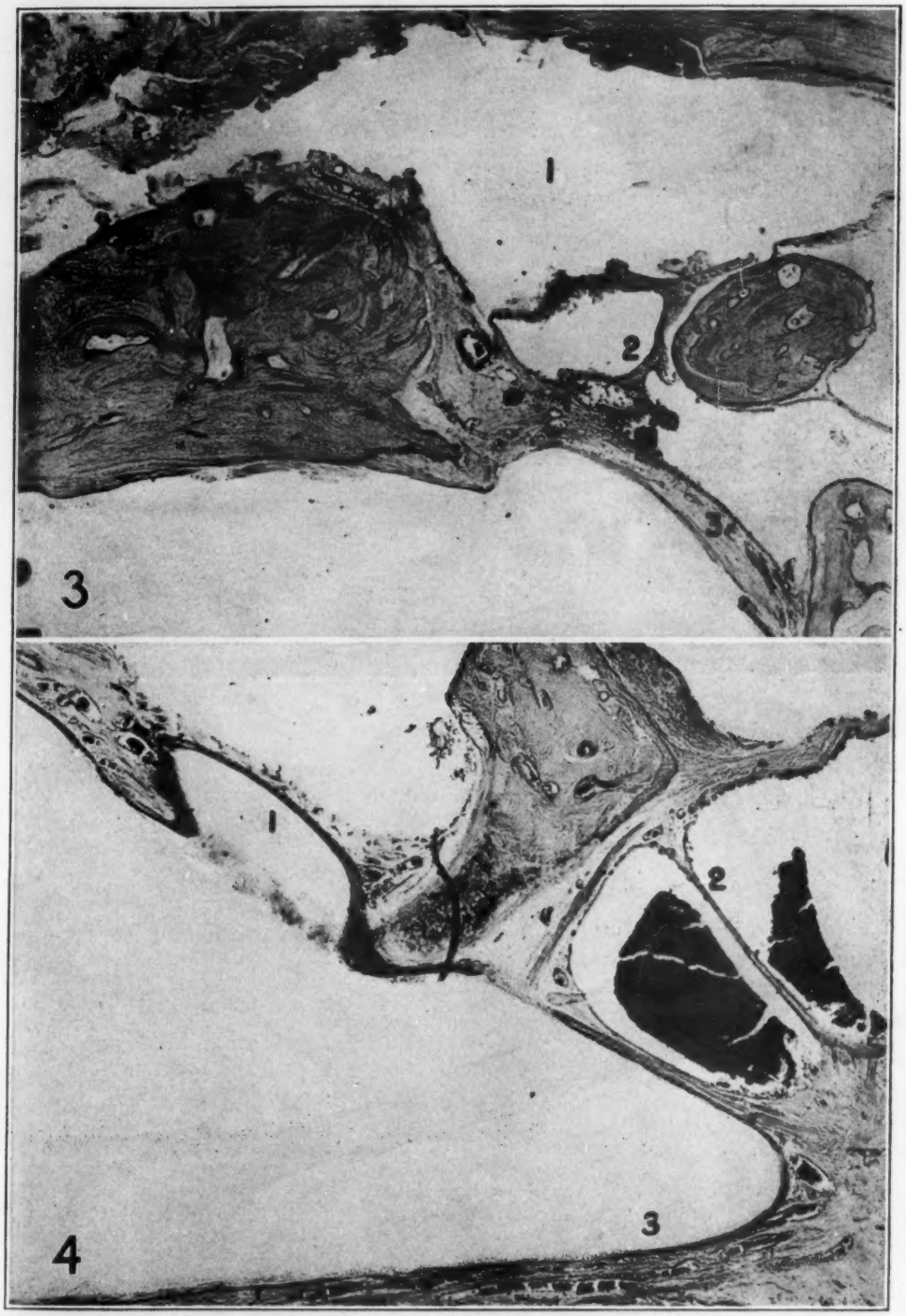

Fig. 3 (H).—Fracture through the posterior wall of the tympanic cavity (*1*), with laceration of ligaments of the malleus (*2*). The tympanic membrane (*3*) is intact.

Fig. 4 (H).—Hemorrhagic infiltration of the tympanic membrane (*1*). Hemorrhage is seen around the ligaments of the malleus (*2*); hyperemia is present in the lining of the external canal (*3*).

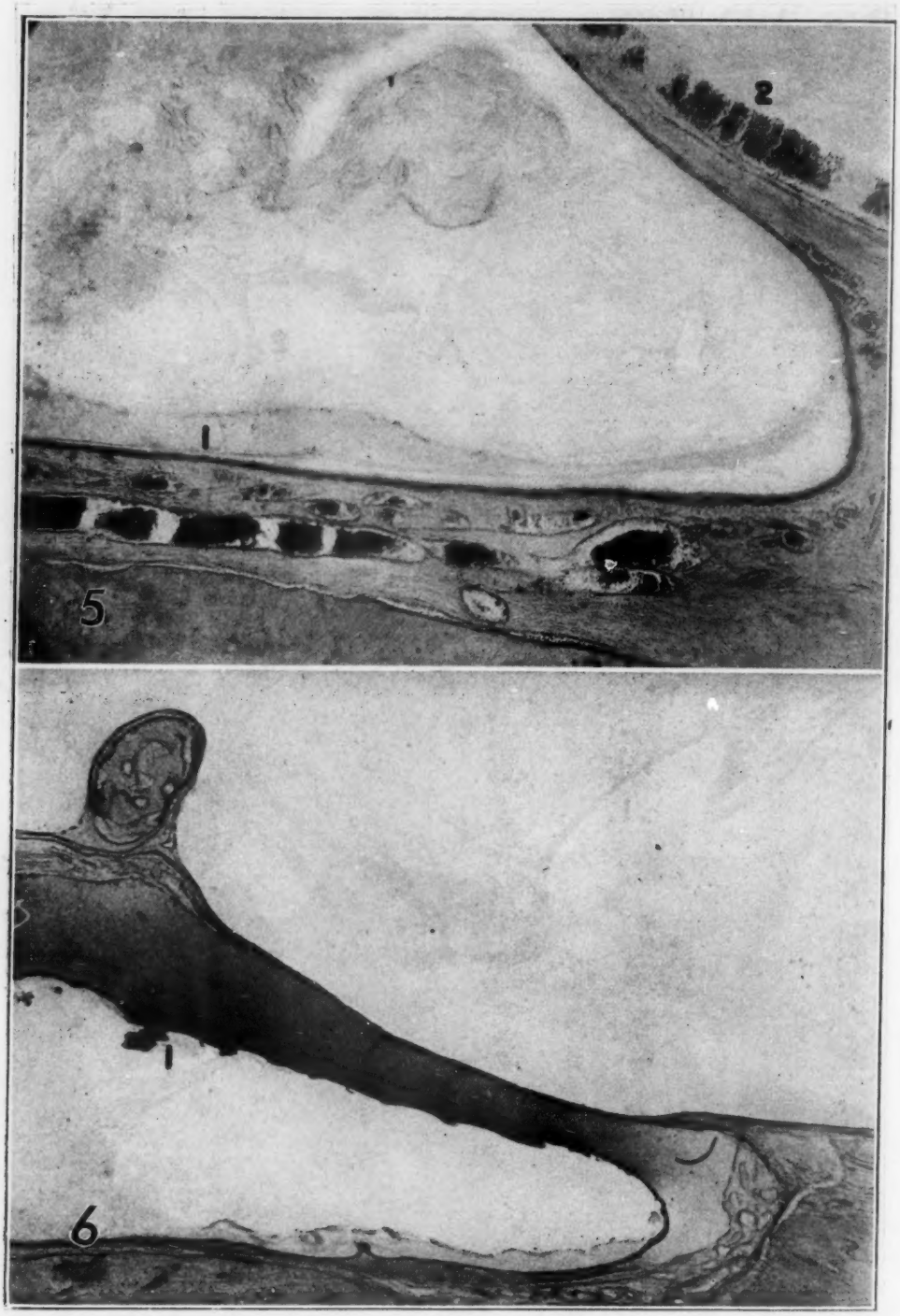

Fig. 5 (H).—Hyperemia in the lining of the external auditory canal (*1*), showing circular and longitudinal vessels. Blood is seen at the tympanic surface of the tympanic membrane (*2*).

Fig. 6 (H).—Edema of the tympanic membrane between the dermic and mucous layer. A hemorrhagic suffusion may be seen (*1*).

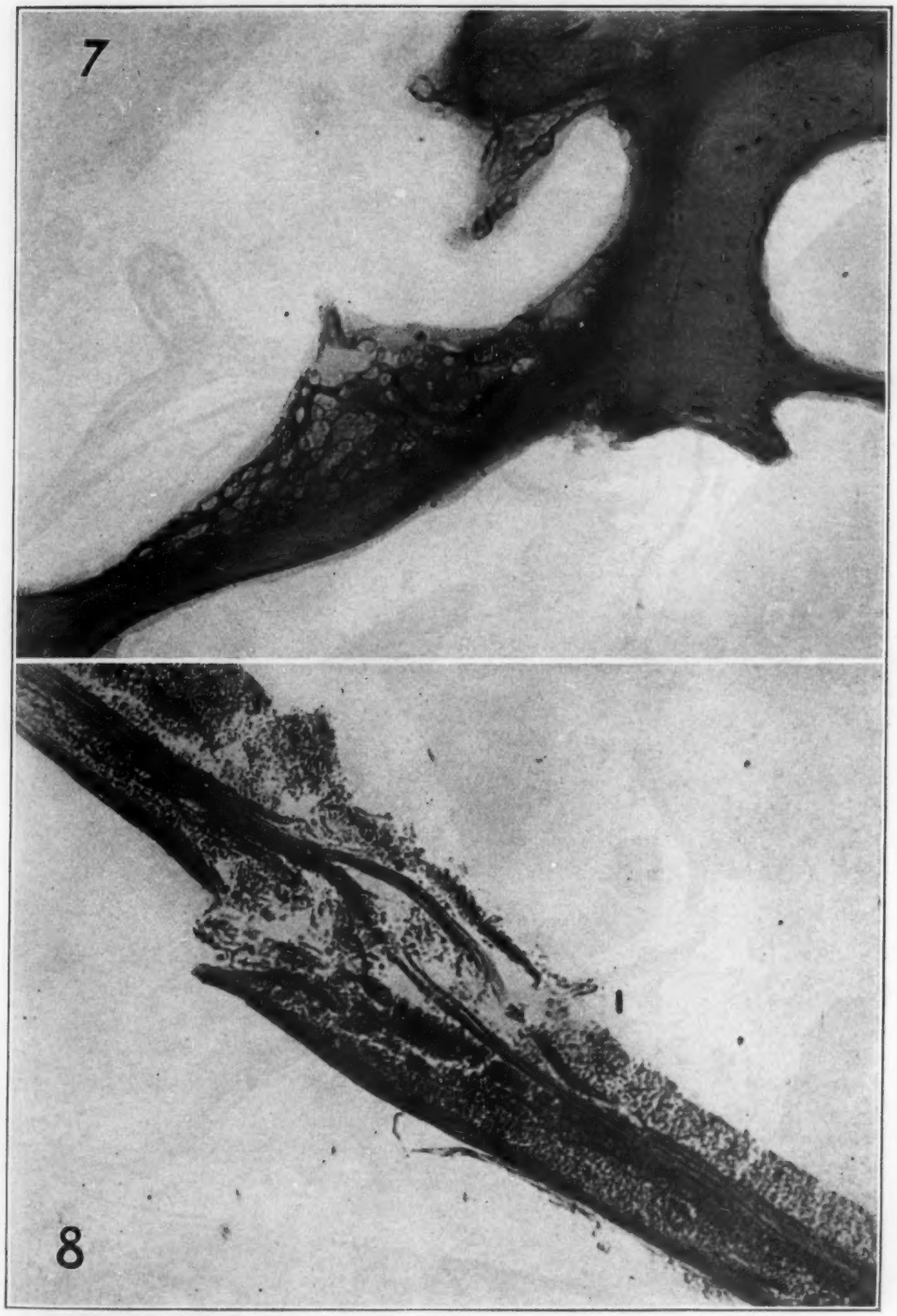

Fig. 7 (H).—Edema and hemorrhagic infiltration of the tympanic membrane. The foamlike appearance is caused by penetrating air producing emphysema within the drum membrane.

Fig. 8 (H).—Rupture of the tympanic membrane involving all three layers. Hemorrhages are present on the tympanic surface (*1*) as well as between the layers of the tympanic membrane.

Fig. 9 (H).—Tympanic membrane showing layers completely separated at the annulus tympanicus (*1*) and the umbo (*2*) without rupture. Hemorrhage is present in the external auditory canal (*3*) and the tympanic cavity (*4*).

Fig. 10 (H).—Rupture of the tympanic membrane, leaving the handle of the malleus (*1*) uncovered. Hemorrhages are seen in the external auditory canal (*2*) and within the tympanic cavity (*3*).

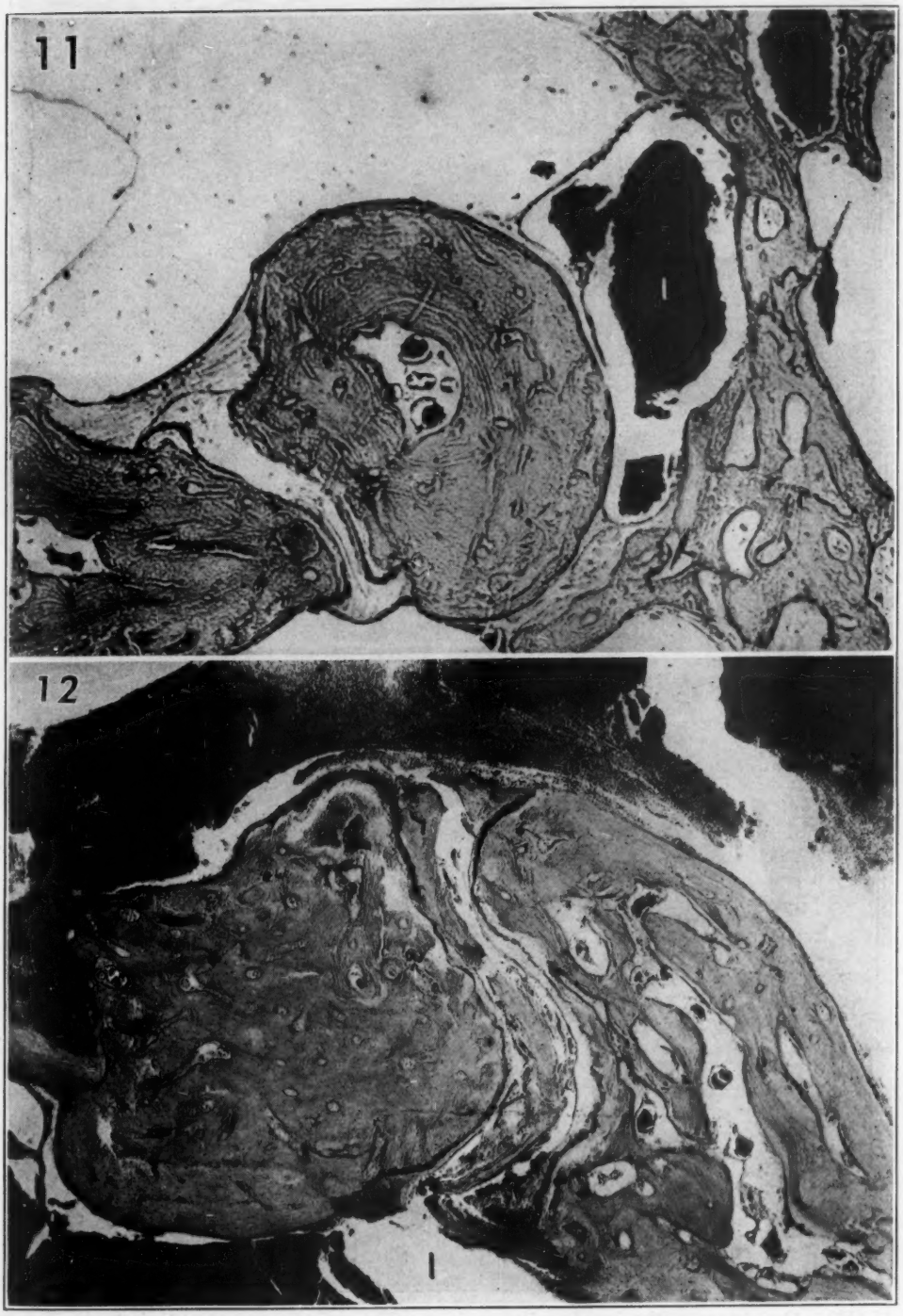

Fig. 11 (H).—Hemorrhage (*1*) between the malleus and the wall of the epitympanic recess (attic).

Fig. 12 (H).—Ossicles with the incudomalleolar joint. The articular capsule (*1*) is torn. The ossicles are embedded in hemorrhage.

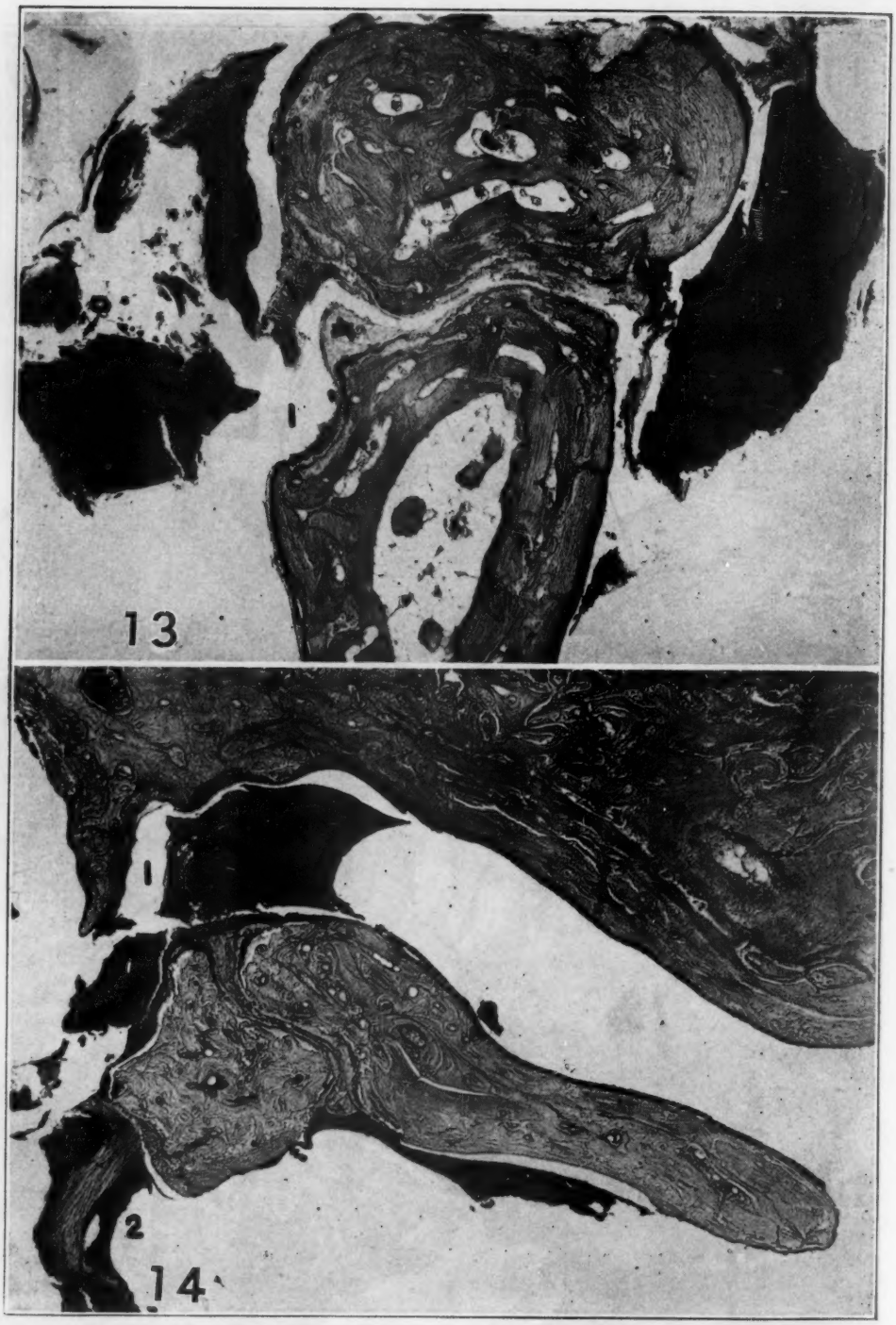

Fig. 13 (H).—Ossicles with the incudomalleolar joint. The articular capsule (*1*) is torn. The ossicles are embedded in hemorrhage.

Fig. 14 (H).—Hemorrhage in the epitympanic recess (*1*). The superior ligament of the malleus (*2*) is lacerated.

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Fig. 16 (H).—Rupture of the tympanic membrane (*1*) with eversion of its torn edges. The chorda tympani (*2*) shows hemorrhagic infiltration.

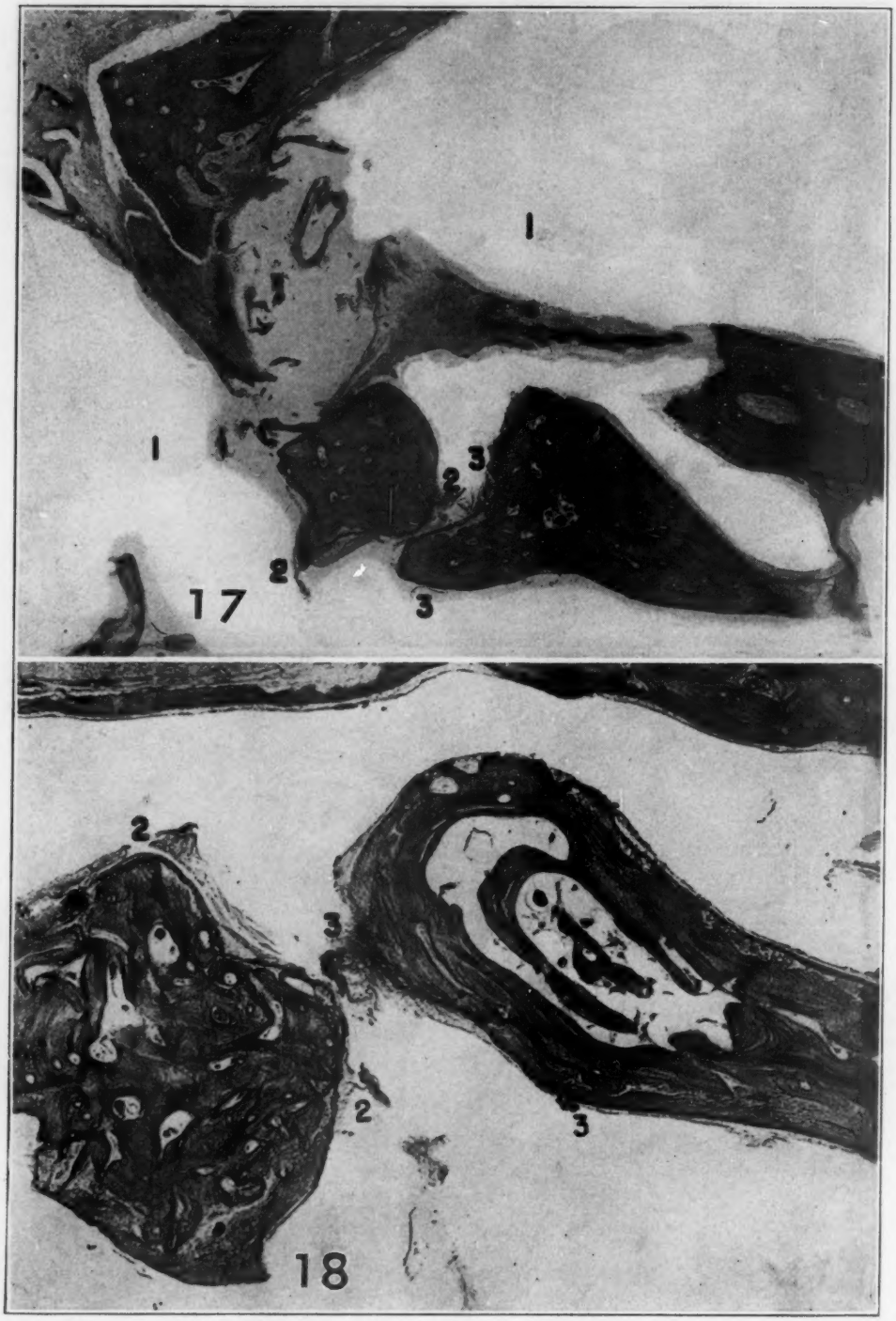

Fig. 17 (H).—Fracture (*1*) of the wall of the epitympanic recess, with luxation in the incudomalleolar joint (between *2-2* and *3-3*).

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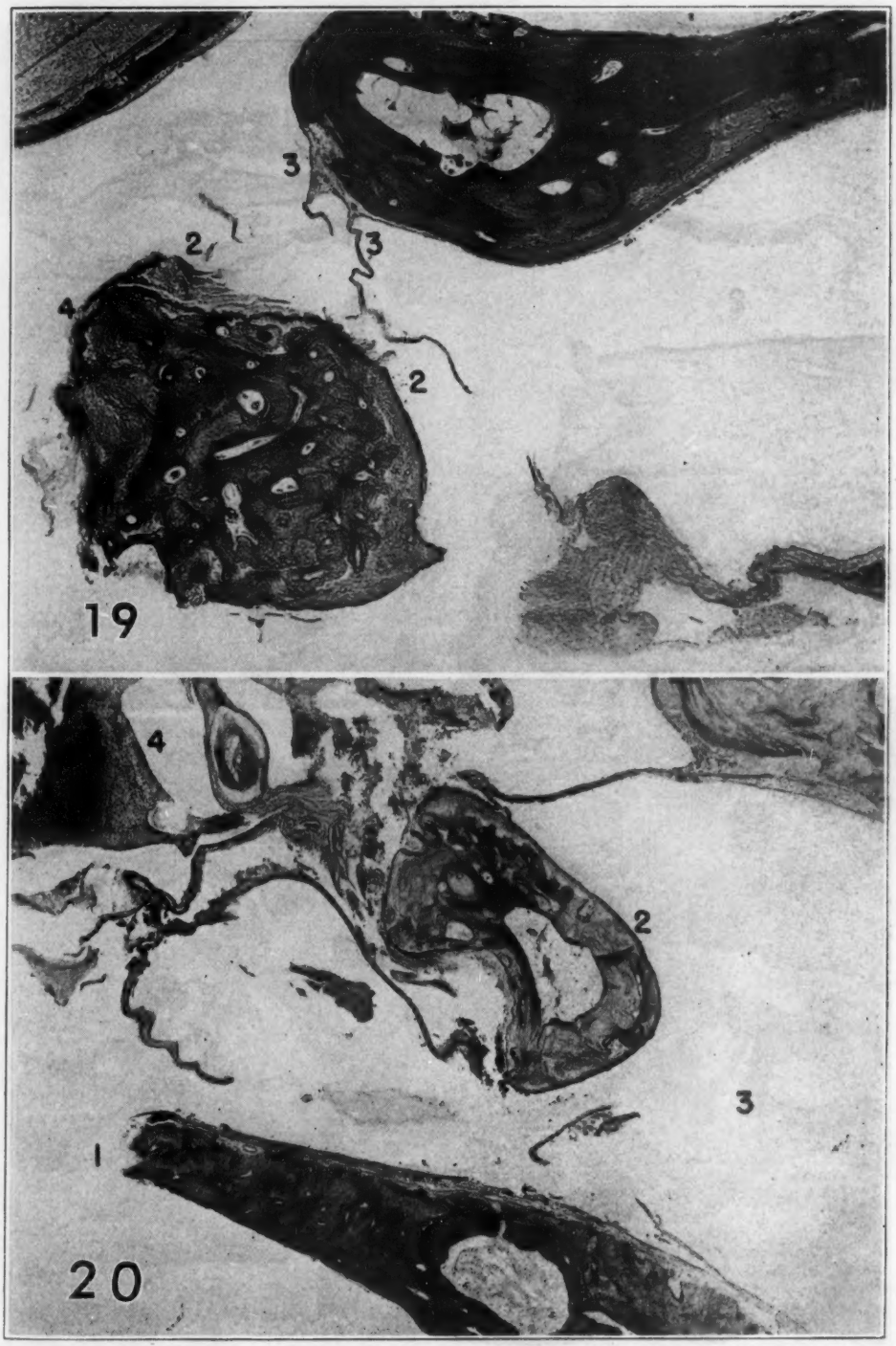

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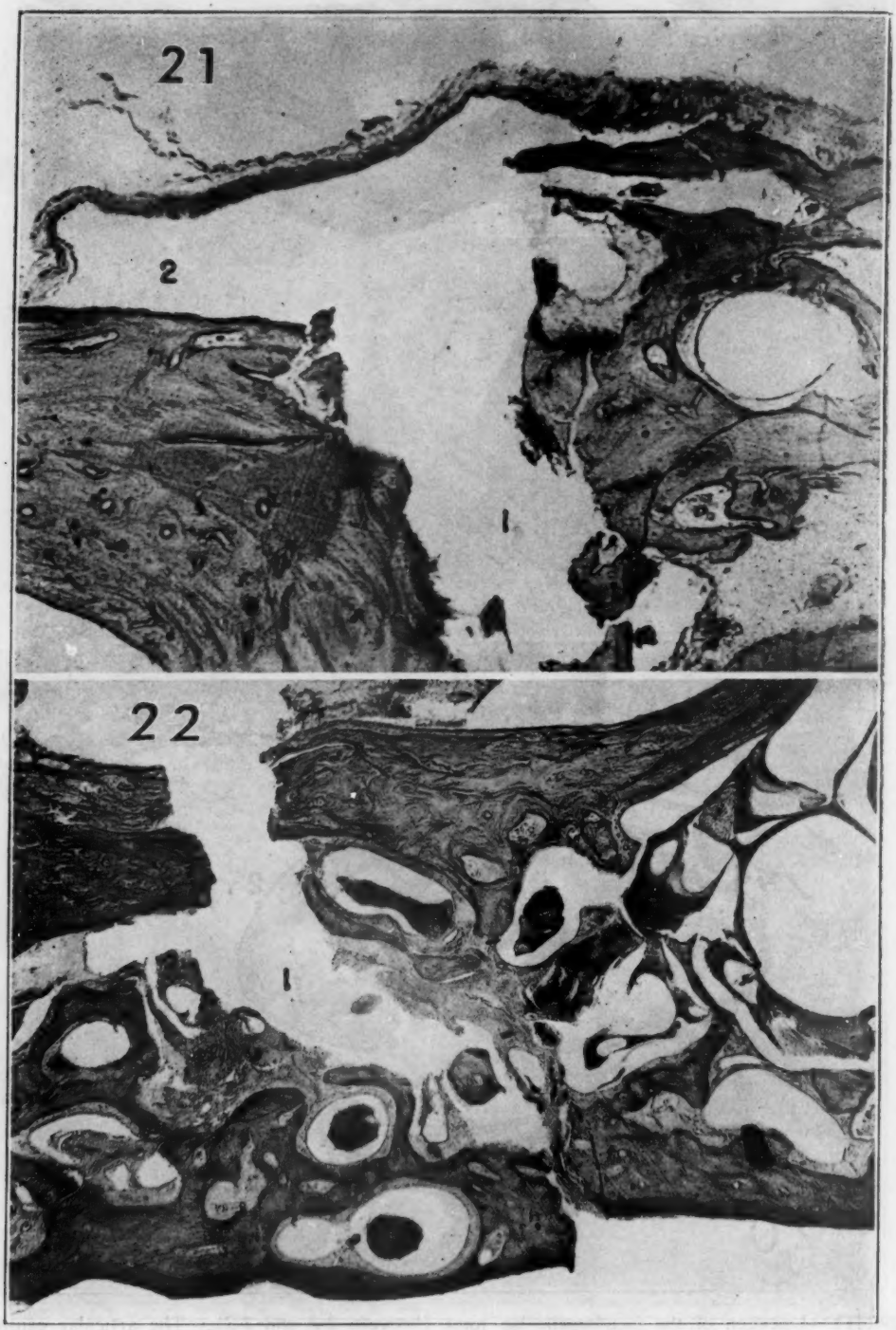

Fig. 21 (H).—Fracture of the tympanic tegmen (*1*), leading into the extradural space. The dura (*2*) is lifted but is intact.

Fig. 22 (H).—Fracture through the tympanic tegmen (*1*). The pneumatic cells contain blood, transudate and exudate, with beginning resorption.

Fig. 23 (H).—Fracture between the pneumatized tympanic tegmen (*1*) and the lateral wall of the internal auditory meatus (*2*). Note the perilymphatic hemorrhage in the superior semicircular canal (*3*).

Fig. 24 (V).—Fracture through the pneumatized tympanic tegmen (*1*). Hemorrhage is seen in the external auditory canal (*2*) and in the acoustic nerve (*3*). Pro nontory (*4*).

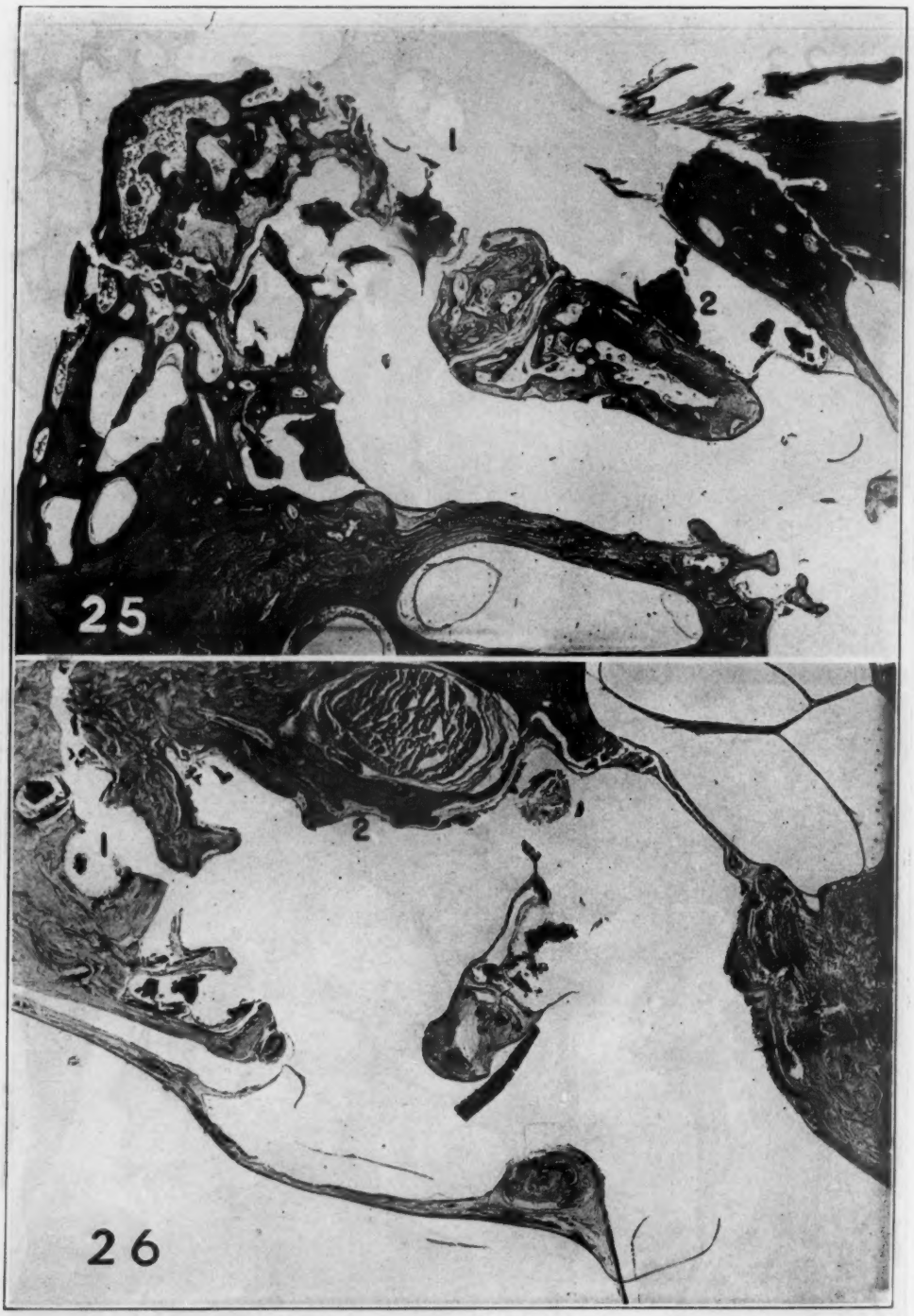

Fig. 25 (H).—Fracture through the tympanic tegmen (*1*). Hemorrhages may be seen in the pneumatic cells and around the ossicles (*2*).

Fig. 26 (H).—Fracture through the tympanic tegmen (*1*) between the annulus tympanicus and the facial canal (*2*).

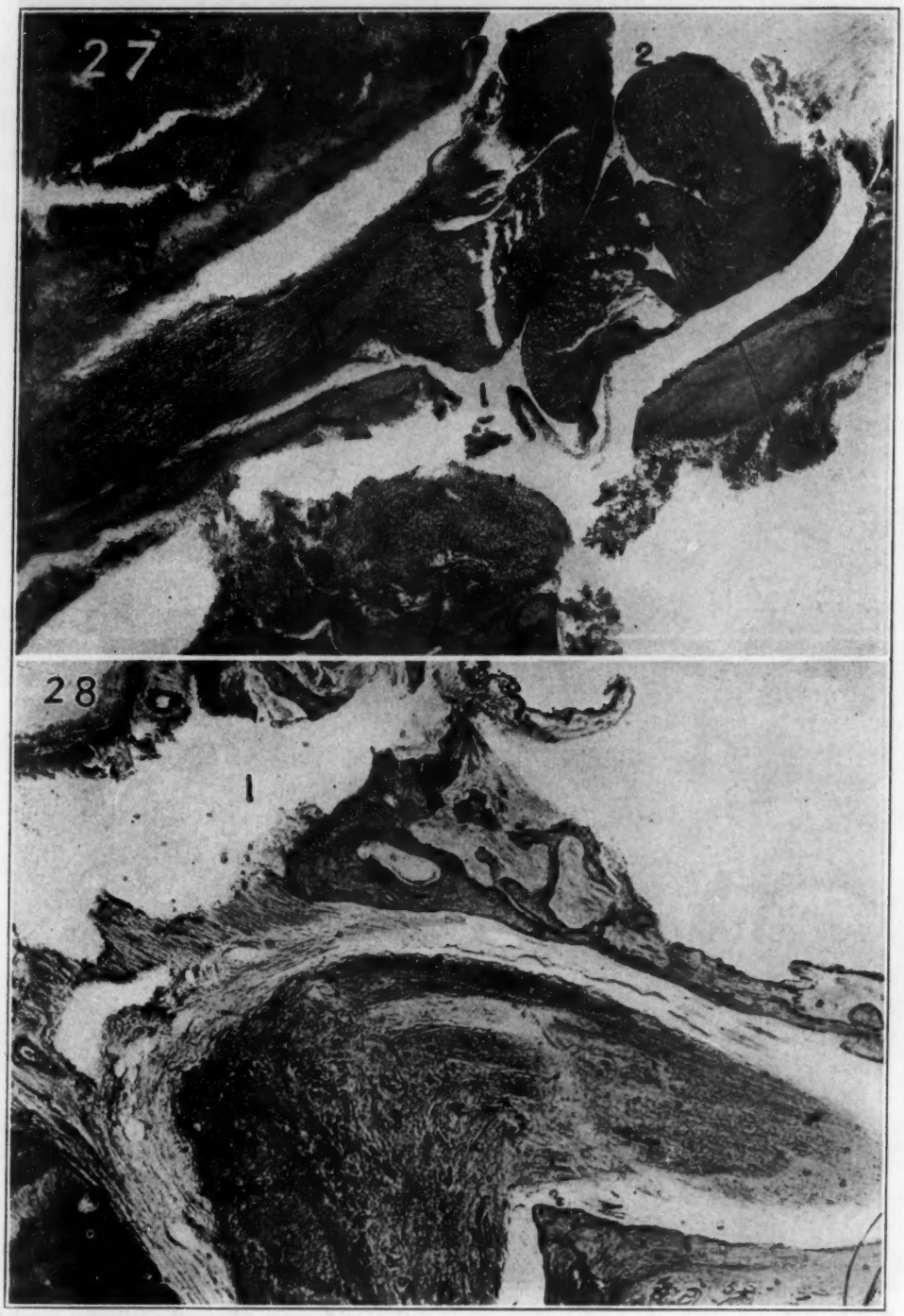

Fig. 27 (H).—Fracture around the geniculate ganglion of the facial nerve (*1*). Adjacent are hemorrhages and exudate, with beginning resorption. Fracture of the tegmen (*2*).

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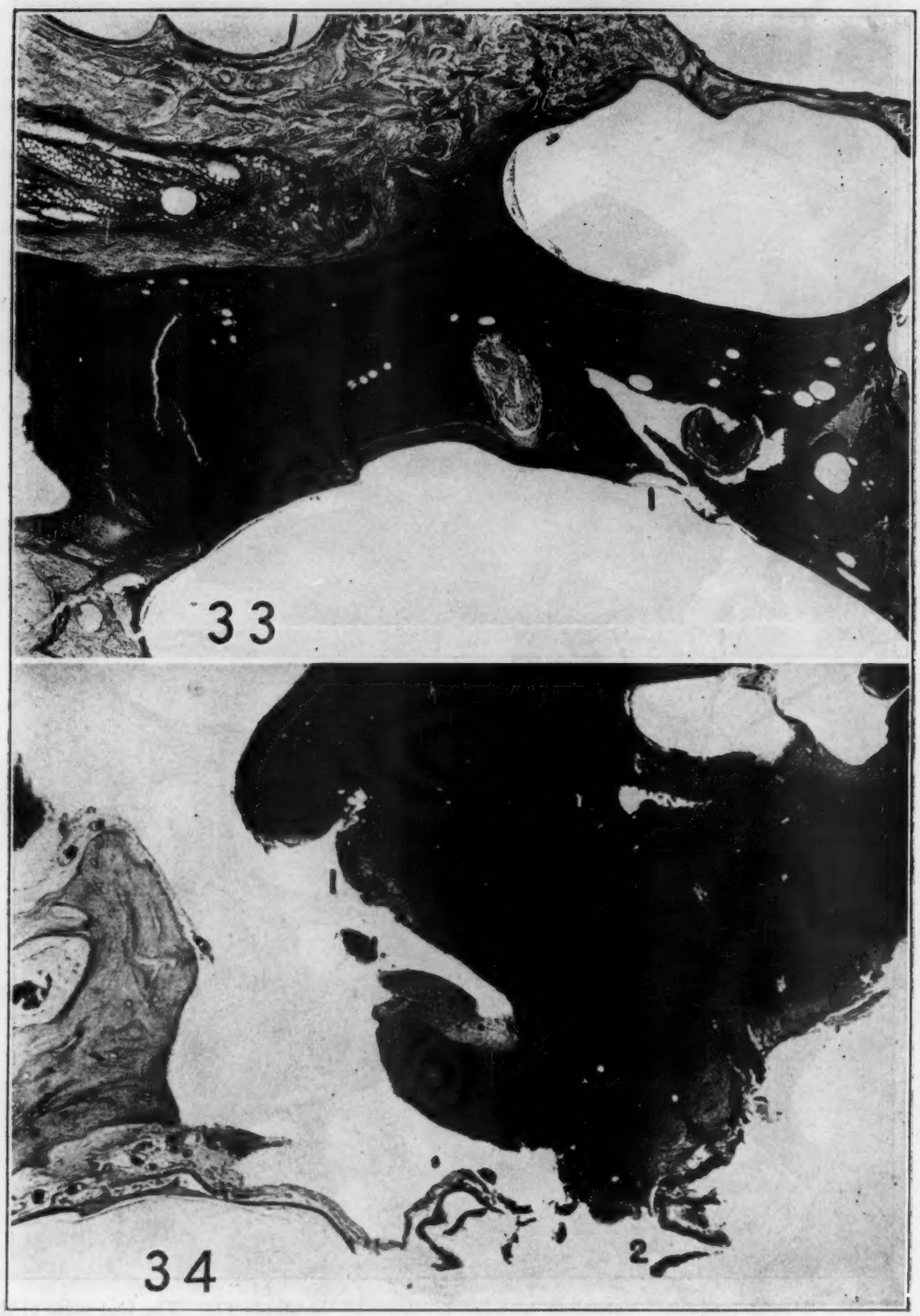

Fig. 33 (H).—Hematotympanum with rupture of the tympanic membrane (*1*).
Fig. 34 (H).—Hematotympanum (*1*) with a severely lacerated tympanic membrane (*2*).

Fig. 35 (H).—Hematotympanum with a torn tympanic membrane (*1*). External auditory canal (*2*). Cochlea (*3*).

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Fig. 37 (V).—Hematotympanum and exudate in the main tympanic cavity (*1*), between the crura of the stapes (*2*) and in the niche of the round window (*3*). Hemorrhage has occurred in the cochlear duct of the basal turn (*4*) and in the utricular macula (*5*).

Fig. 38 (H).—Rupture of the tympanic membrane (*1*), with lacerated malleolar ligament (*2*). A fragment (*3*) of the fractured wall of the external auditory canal has penetrated through the tympanic membrane into the tympanic cavity (*4*); the latter is filled with blood.

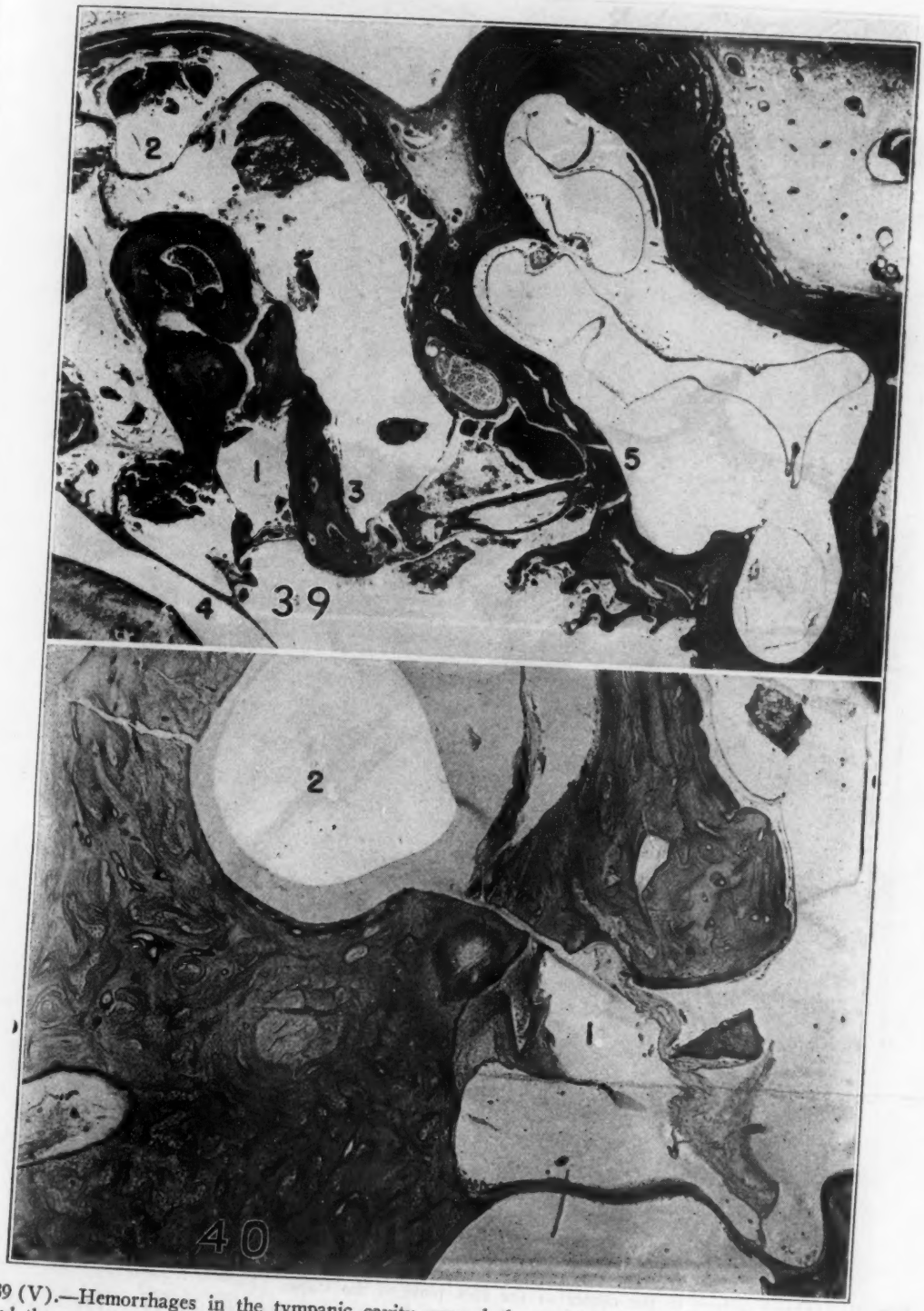


Fig. 39 (V).—Hemorrhages in the tympanic cavity around the ossicles (*1*), in the epitympanic recess (*2*) and around the stapes (*3*). External auditory canal (*4*). Vestibulum (*5*).

Fig. 40 (H).—Fracture leading from the hypotympanum (*1*) into the carotid canal (*2*).

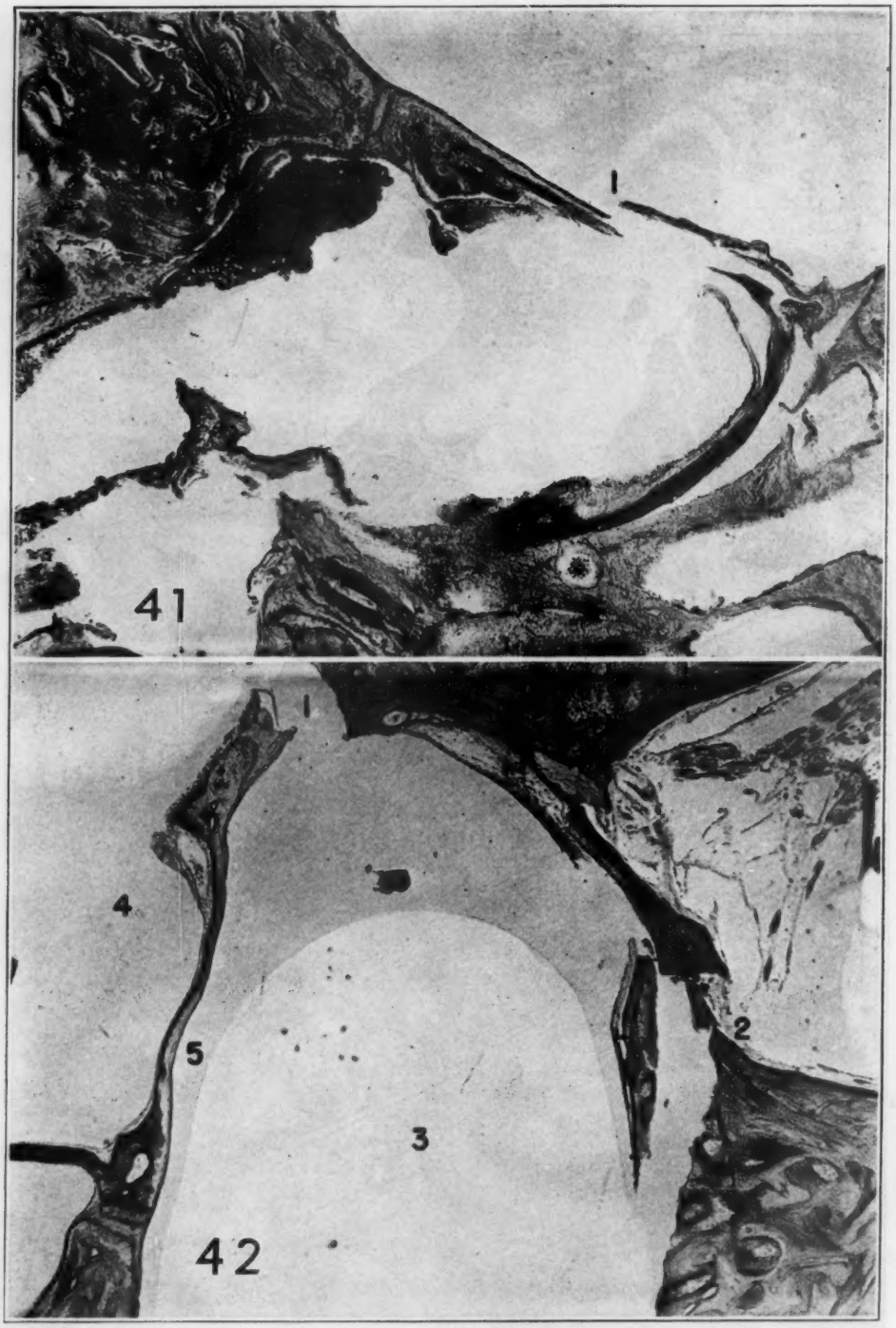


Fig. 41 (H).—Fracture in the center of the foot plate of the stapes (*1*).

Fig. 42 (H).—Luxation of the stapes due to laceration of the annular ligament (*1*). Fracture of the wa of the fundus of the internal auditory meatus (*2*). Vestibulum (*3*). Tympanic cavity (*4*). Foot plate of th stapes (*5*).

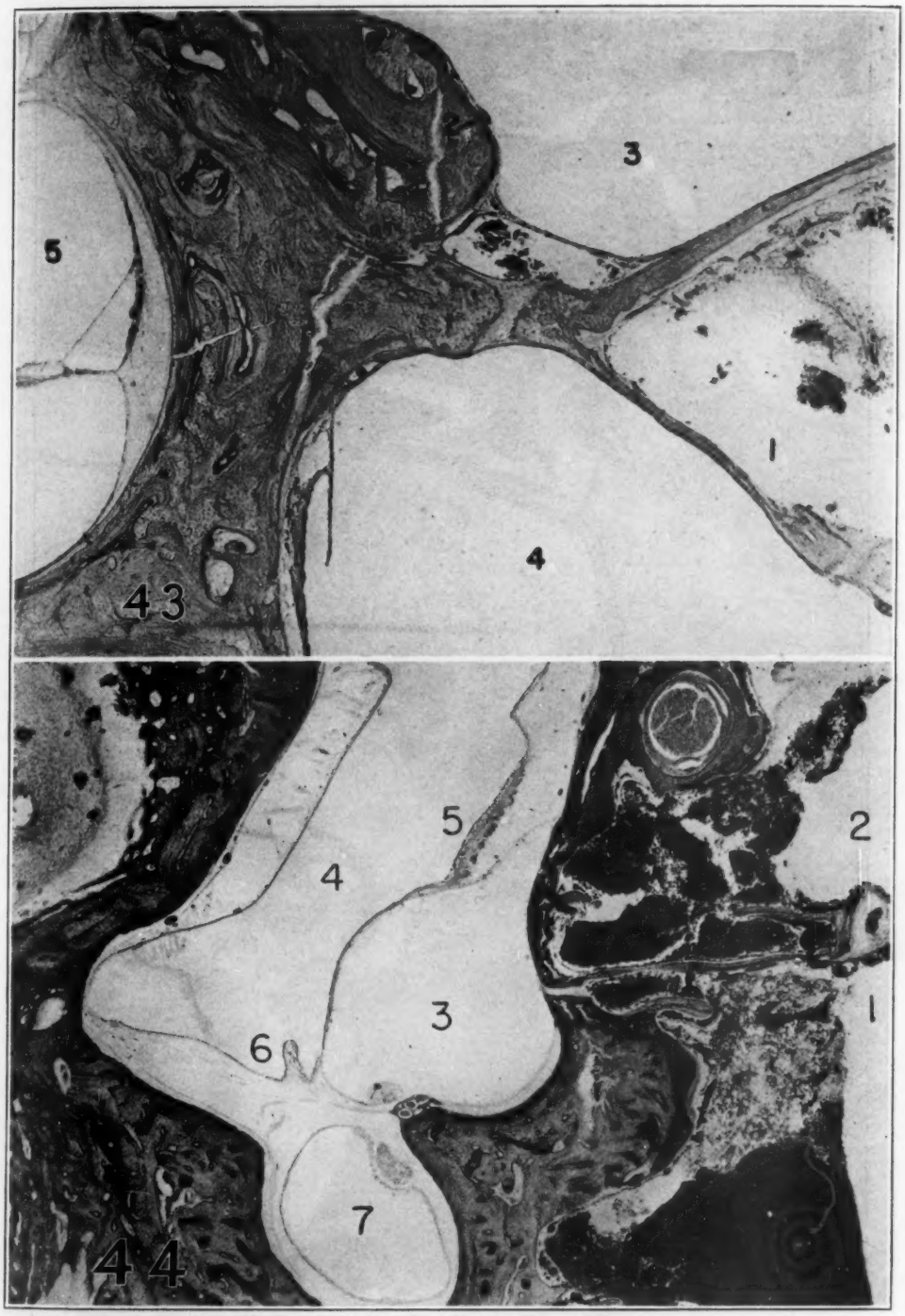


Fig. 43 (H).—Fissures around the fissula ante fenestram *(2)*. Hemorrhages in the intercrural space *(1)*. Tympanic cavity *(3)*. Vestibulum *(4)*. Cochlea *(5)*.

Fig. 44 (V).—Stapes embedded in a hemorrhage. Head of stapes *(1)*. Tympanic cavity *(2)*. Perilymphatic cisterna *(3)*. Utriculus *(4)*. Macula utriculi *(5)*. Crista neglecta, in the sinus utricularis inferior *(6)*. Posterior ampulla with crista *(7)*.

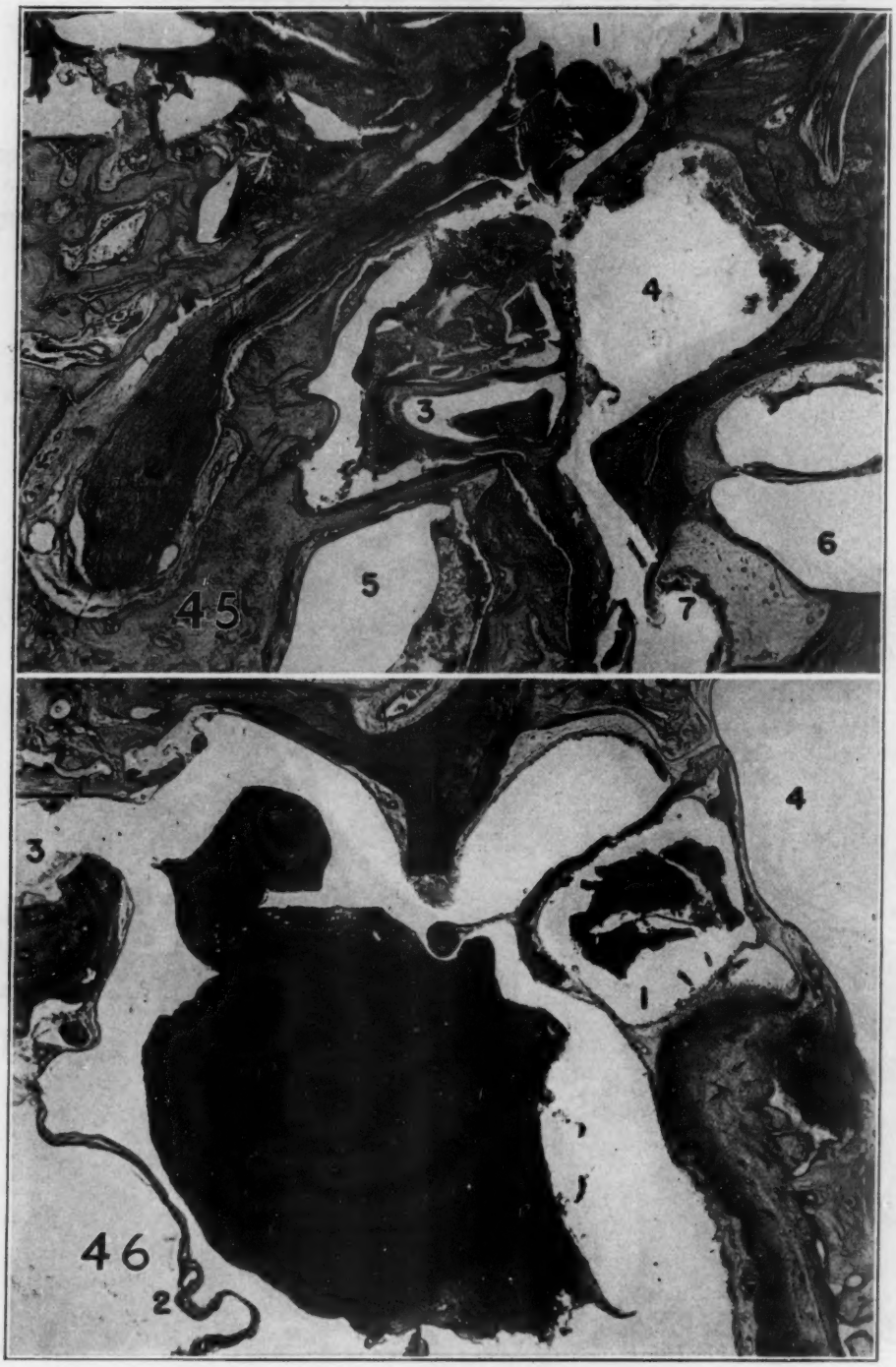


Fig. 45 (H).—Fracture of the facial canal at the geniculate ganglion (*1*). Facial nerve (*2*). Stapes (*3*), luxated, in the tympanic cavity (*4*). Vestibulum (*5*). Cochlea (*6*). Niche of the round window (*7*).

Fig. 46 (H).—Hematotympanum with filling of the intercrural space (*1*). Rupture of the tympanic membrane (*2*). Fracture of the tegmen (*3*). Vestibulum (*4*).

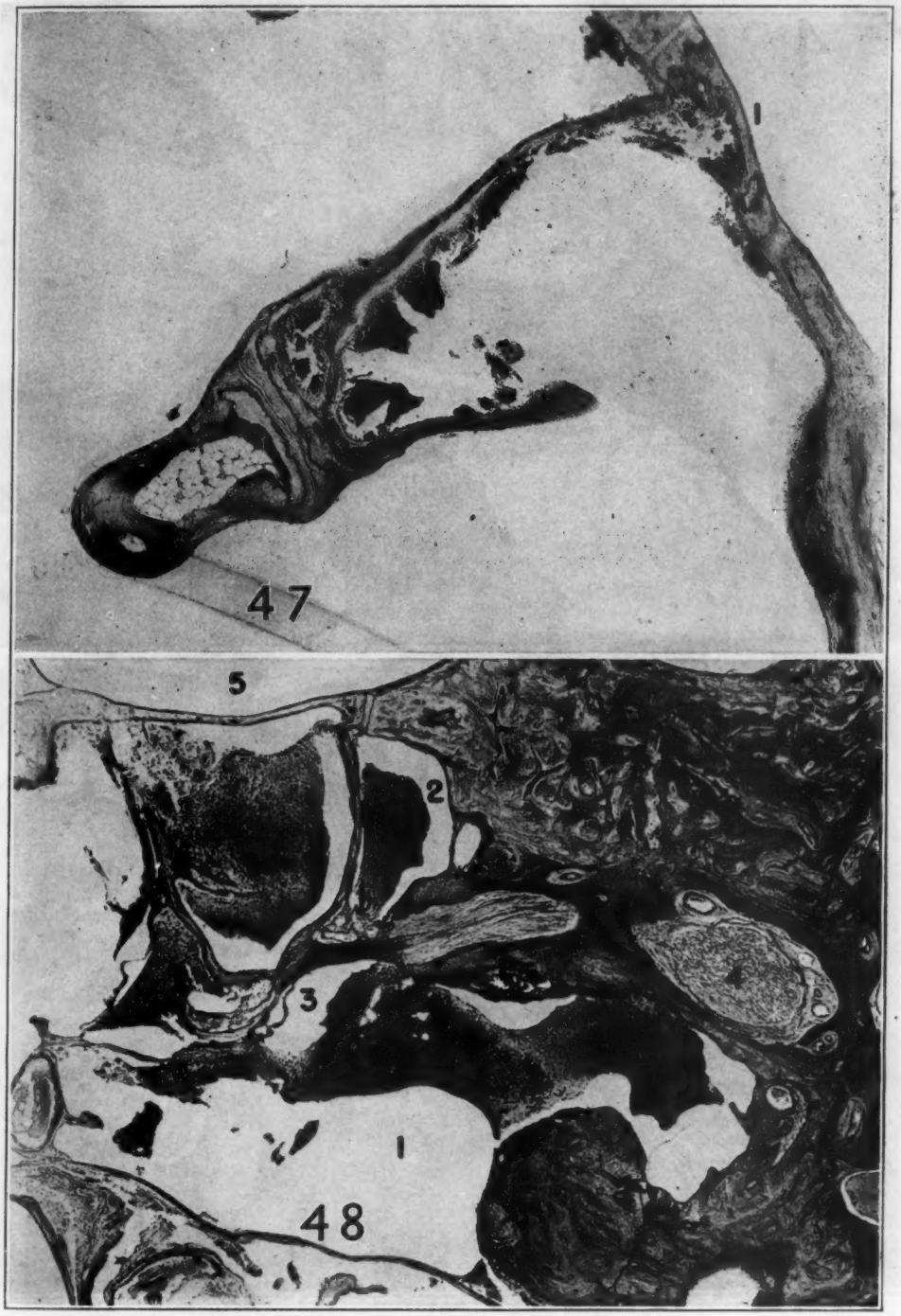


Fig. 47 (H).—Incomplete fracture of the stapedial plate (*1*).

Fig. 48 (H).—Hemorrhage in the tympanic cavity (*1*) filling the niche of the oval window (*2*). Hemorrhagic infiltration of the stapedial tendon (*3*). Facial nerve (*4*). Vestibulum (*5*).

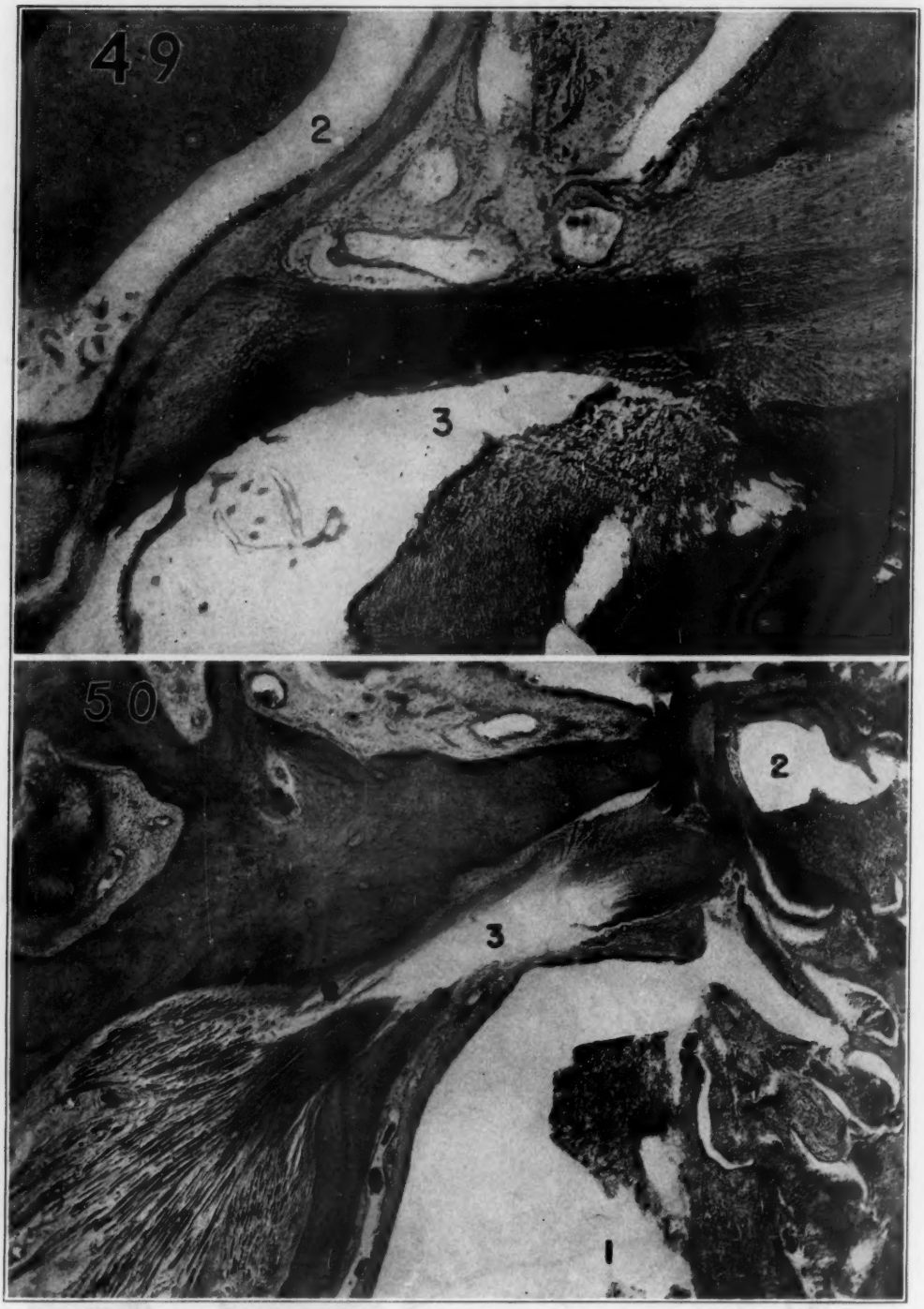


Fig. 49 (H).—Part of figure 48: hemorrhagic infiltration of the stapedial tendon (*3*). Crus posterius of the stapes (*2*).

Fig. 50 (H).—Hemorrhage and exudate in the tympanic cavity (*1*), with beginning of resorption. The stapes (*2*) is fractured, and part of it has been torn away by the stapedial tendon (*3*).

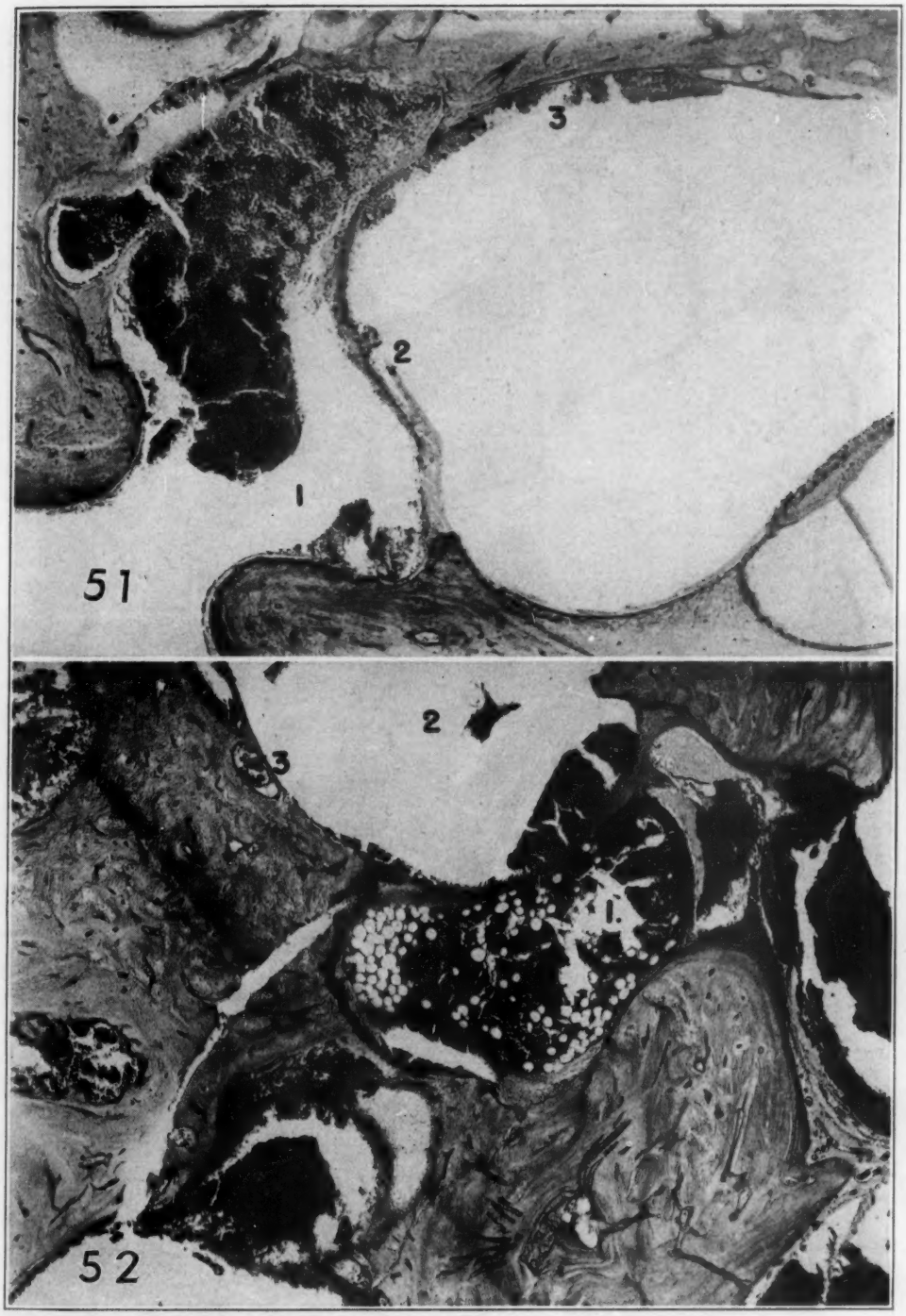


Fig. 51 (H).—Hemorrhage in the niche of the round window (*1*). Secondary tympanic membrane (*2*). Hemorrhage in the basal turn (*3*) of the cochlea.

Fig. 52 (H).—Hemorrhage in the niche of the round window (*1*) and in the basal turn (*2*) of the cochlea, penetrating into the cochlear orifice of the cochlear aqueduct (*3*).

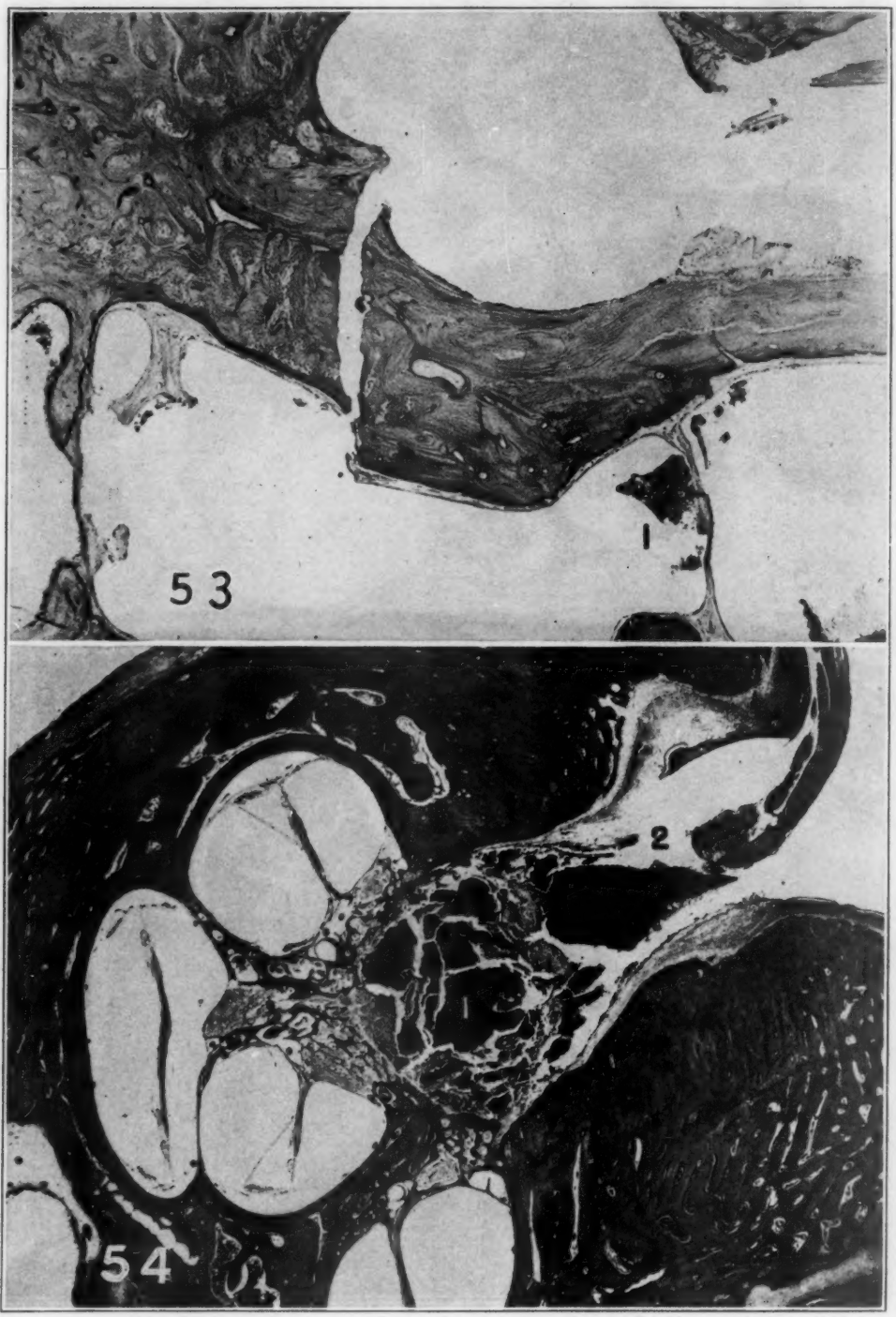


Fig. 53 (H).—Fracture through the wall of the tympanic cavity. Hemorrhage is seen on the tympanic surface of the tympanic membrane (*1*).

Fig. 54 (V).—Hemorrhage in the internal auditory meatus (*1*) with laceration of the acoustic nerve (*2*).

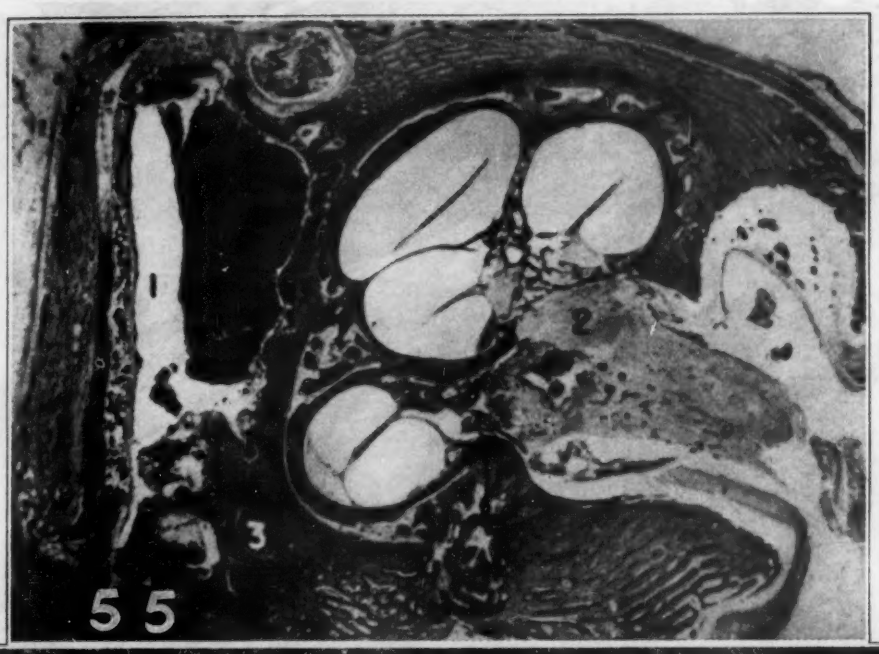


Fig. 55 (V).—Hemorrhage in the tympanic cavity (*1*), in the cochlear nerve (*2*) in the fundus and in the eustachian tube (*3*).

Fig. 56 (H).—Hemorrhage in the scala tympani (*1*) and the scala vestibuli (*2*).

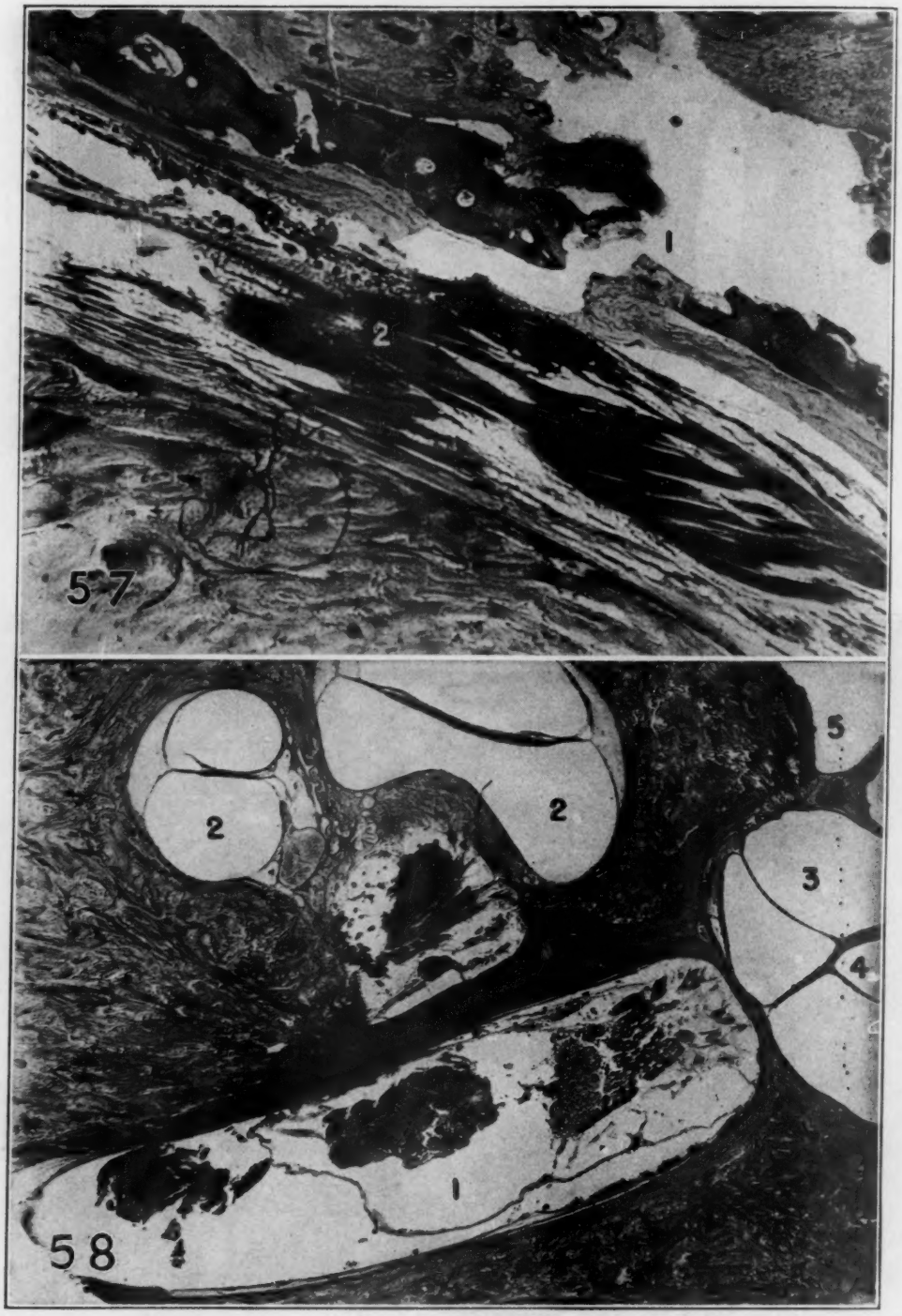


Fig. 57 (H).—Fracture of the wall of the canalis musculotubarius (*1*). Hemorrhagic infiltration of the tensor tympani muscle (*2*).

Fig. 58 (H).—Hemorrhage in the internal auditory meatus (*1*). Cochlea (*2*). Cisterna perilymphatica (*3*). Macula utriculi (*4*). Oval ligament (*5*).

Fig. 59 (H).—Hemorrhage in the tympanic cavity (*1*) and the perilabyrinthine cells (*2*). Cochlea (*3*).
Fig. 60 (V).—Hemorrhage in the cochlear (*1*) and the vestibular (*2*) branch of the acoustic nerve (*3*).

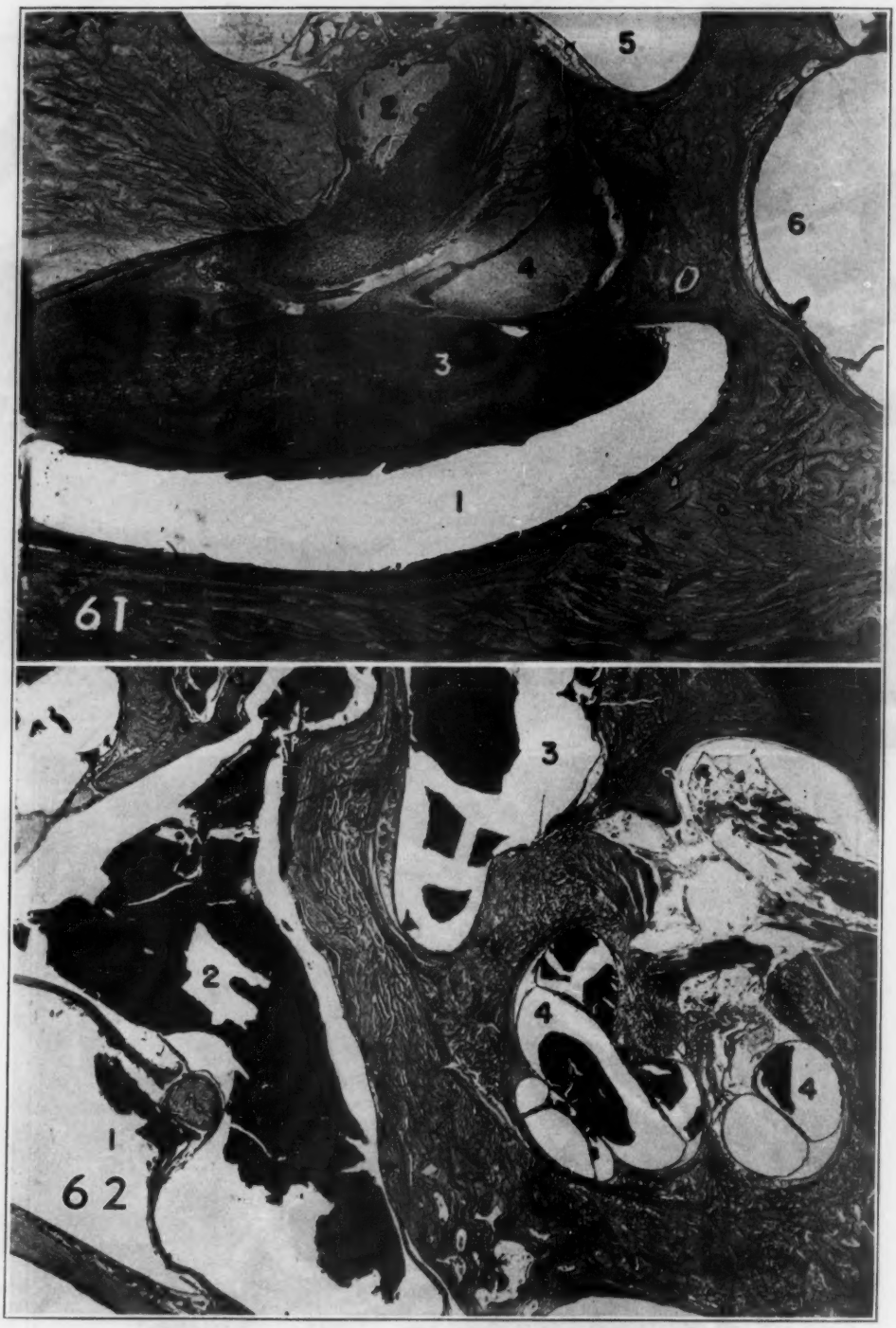


Fig. 61 (H).—Hemorrhage in the internal auditory meatus (*1*). Cochlear nerve (*2*). Vestibular nerve (*3*). Exudate between the two branches (*4*). Cochlea (*5*). Vestibulum (*6*).

Fig. 62 (H).—Hemorrhage in the external auditory canal (*1*), the tympanic cavity (*2*), the vestibulum (*3*), the cochlea (*4*). Compare with figure 56.

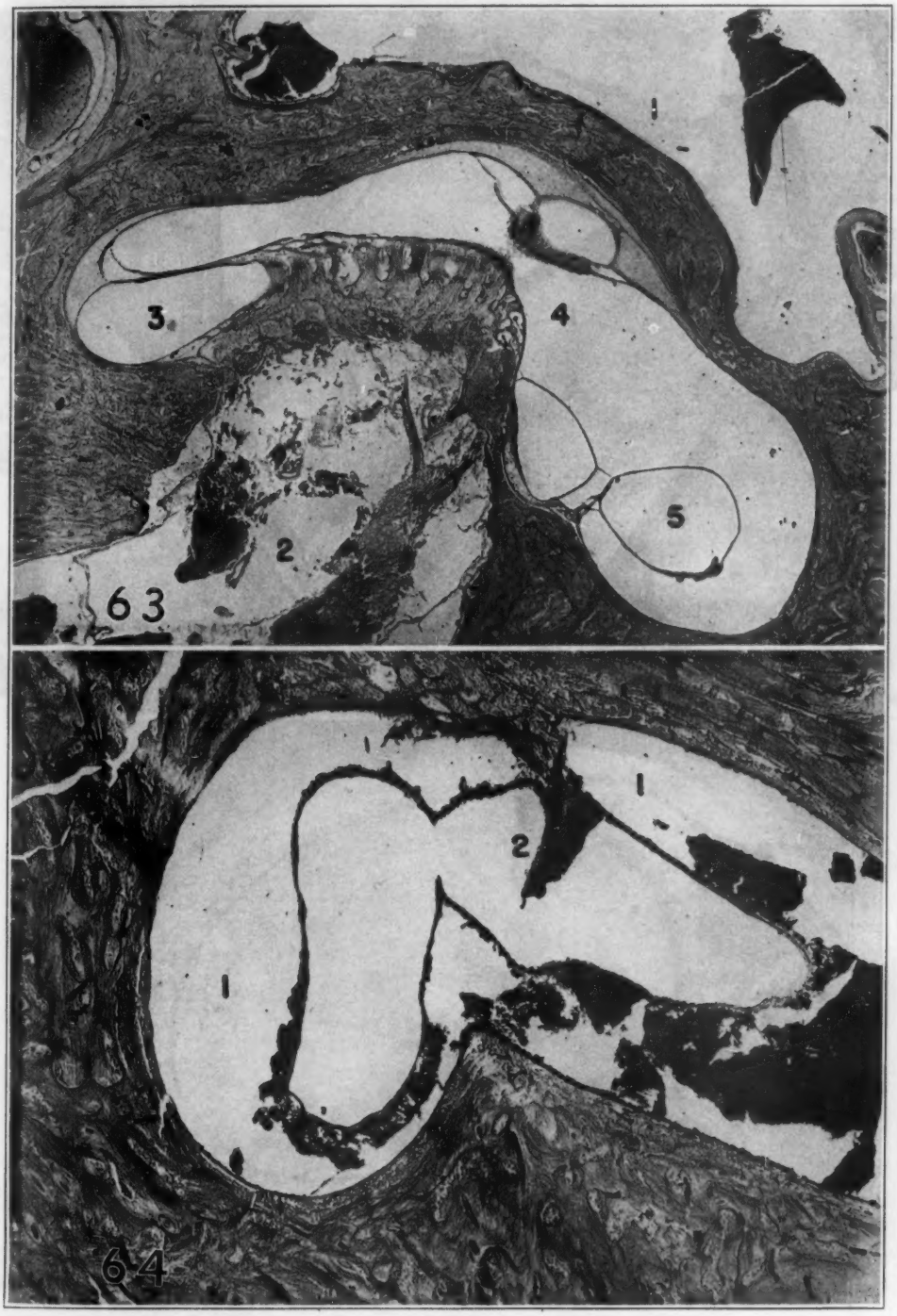
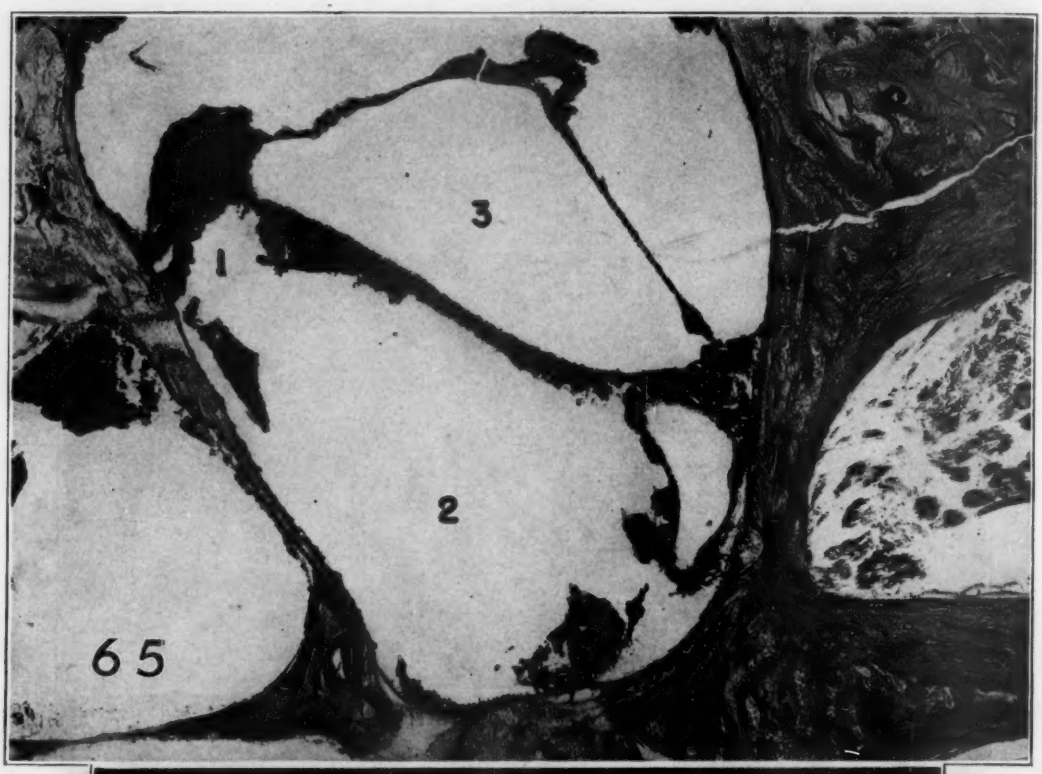


Fig. 63 (H).—Hemorrhage in the tympanic cavity (*1*) and the internal auditory meatus (*2*). Cochlea (*3*). Macula sacculi (*4*). Utriculus with macula neglecta (*5*).

Fig. 64 (H).—Hemorrhage in the perilymphatic space of the superior and the lateral ampulla. Cisterna perilymphatica *(1)*. Endolymphatic space free except for the hemorrhagic infiltration of the lateral crista (*2*).



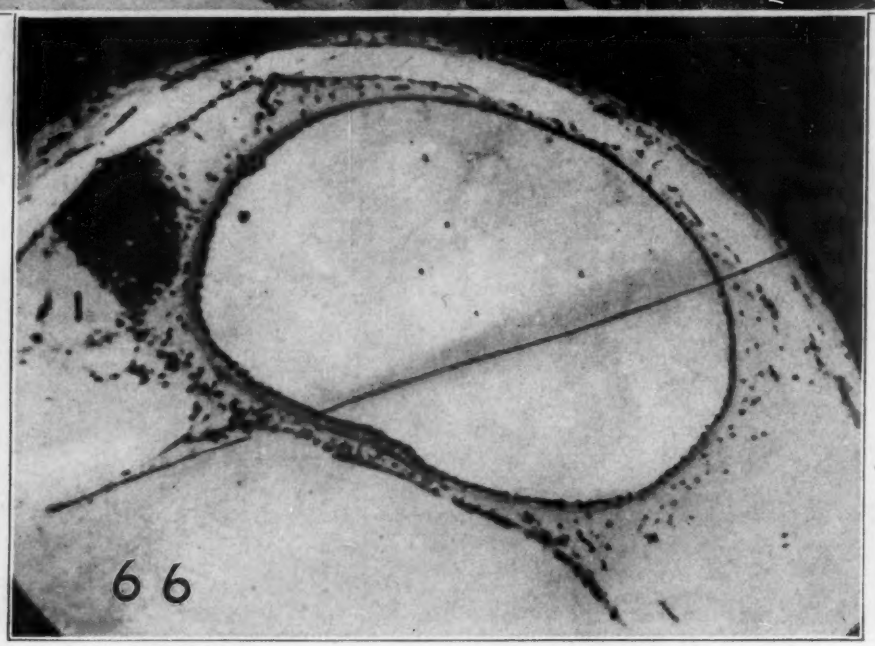


Fig. 65 (H).—Hemorrhage around the oval ligament (*1*) and in the perilymphatic cisterna (*2*), leaving the utriculus (*3*) free. Note the fissure through the wall of the internal auditory meatus (*4*).

Fig. 66 (V).—Round cell infiltration (*1*) as the first reaction to injury in the perilymphatic network of the semicircular canal.

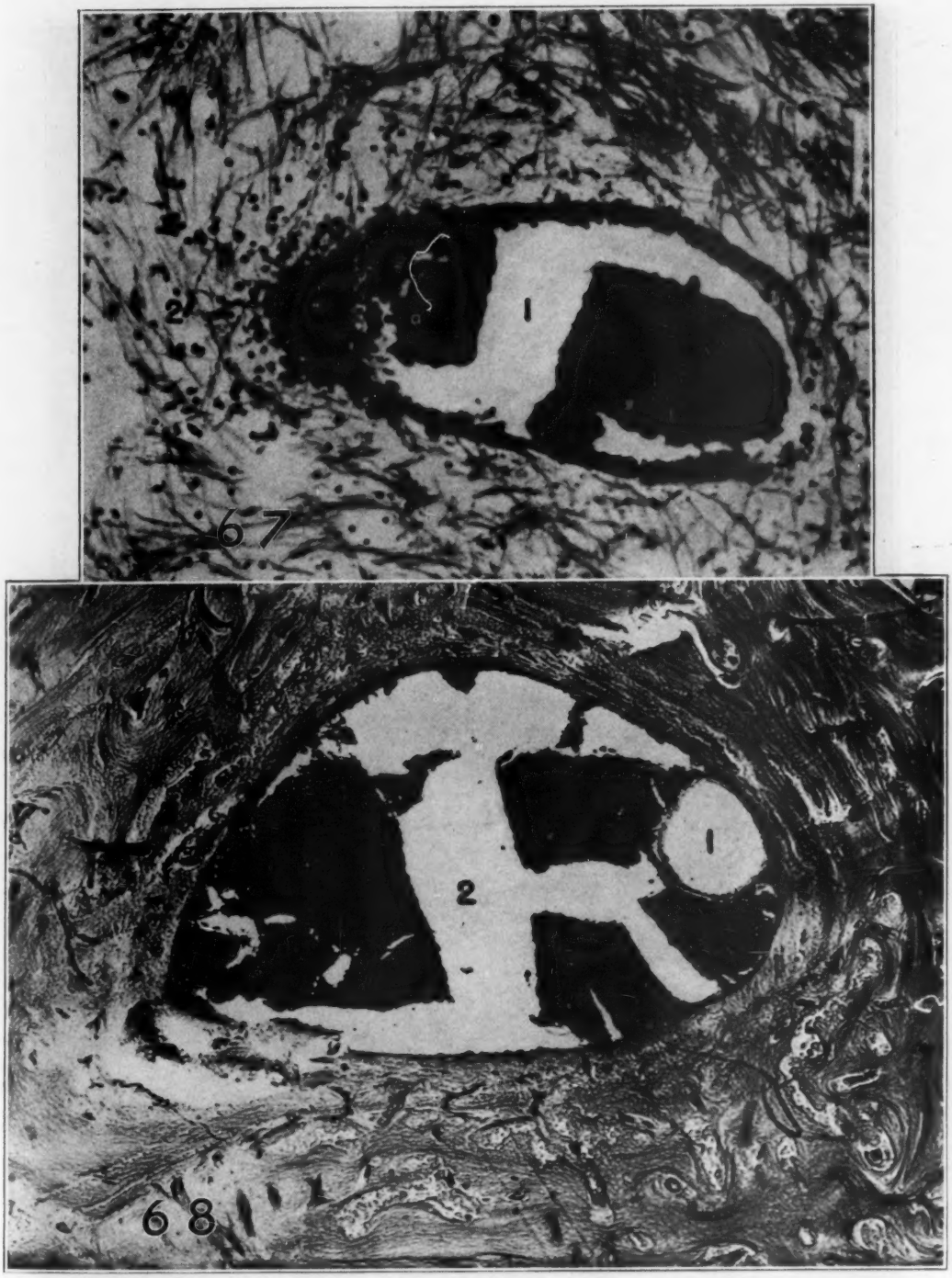


Fig. 67 (H).—Hemorrhage in the endolymphatic space (*1*) of a semicircular canal; round cell infiltration (*2*) in the wall of the semicircular duct and in the perilymphatic network.

Fig. 68 (H).—Hemorrhage in the perilymphatic space of the semicircular canal (*2*), leaving the endolymphatic space (*1*) free.

Fig. 69 (H).—Hemorrhage in the perilymphatic network (*2*) of a semicircular canal. The major part of the perilymphatic space and the entire endolymphatic space (*1*) are free.

Fig. 70 (H).—Hemorrhage and exudate in many perilabyrinthine cells; the semicircular canal (*1*) is free.

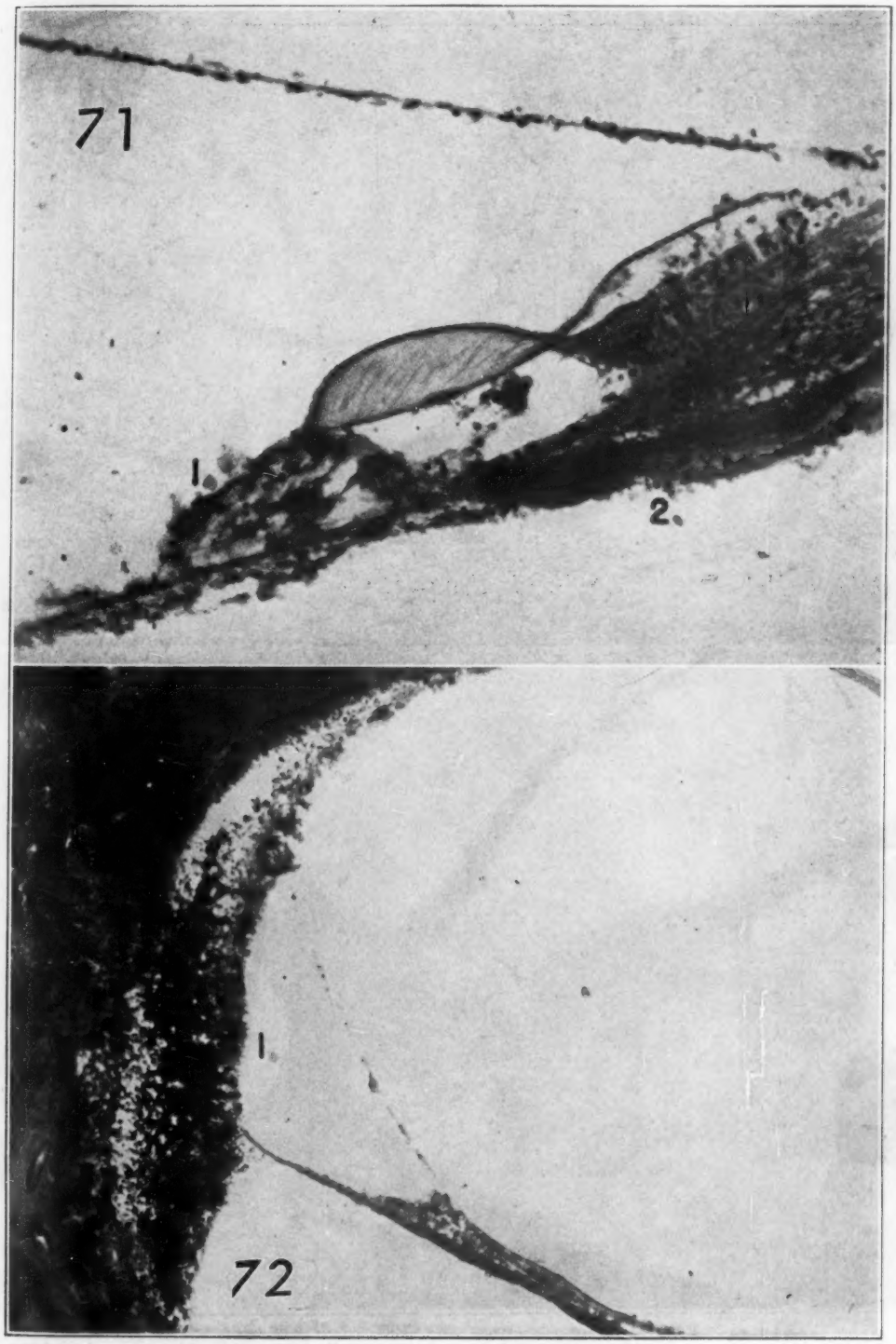


Fig. 71 (V).—Hemorrhagic infiltration of Corti's organ (*1*) and of the basilar membrane (*2*).
Fig. 72 (V).—Hemorrhagic infiltration of the stria vascularis (*1*).

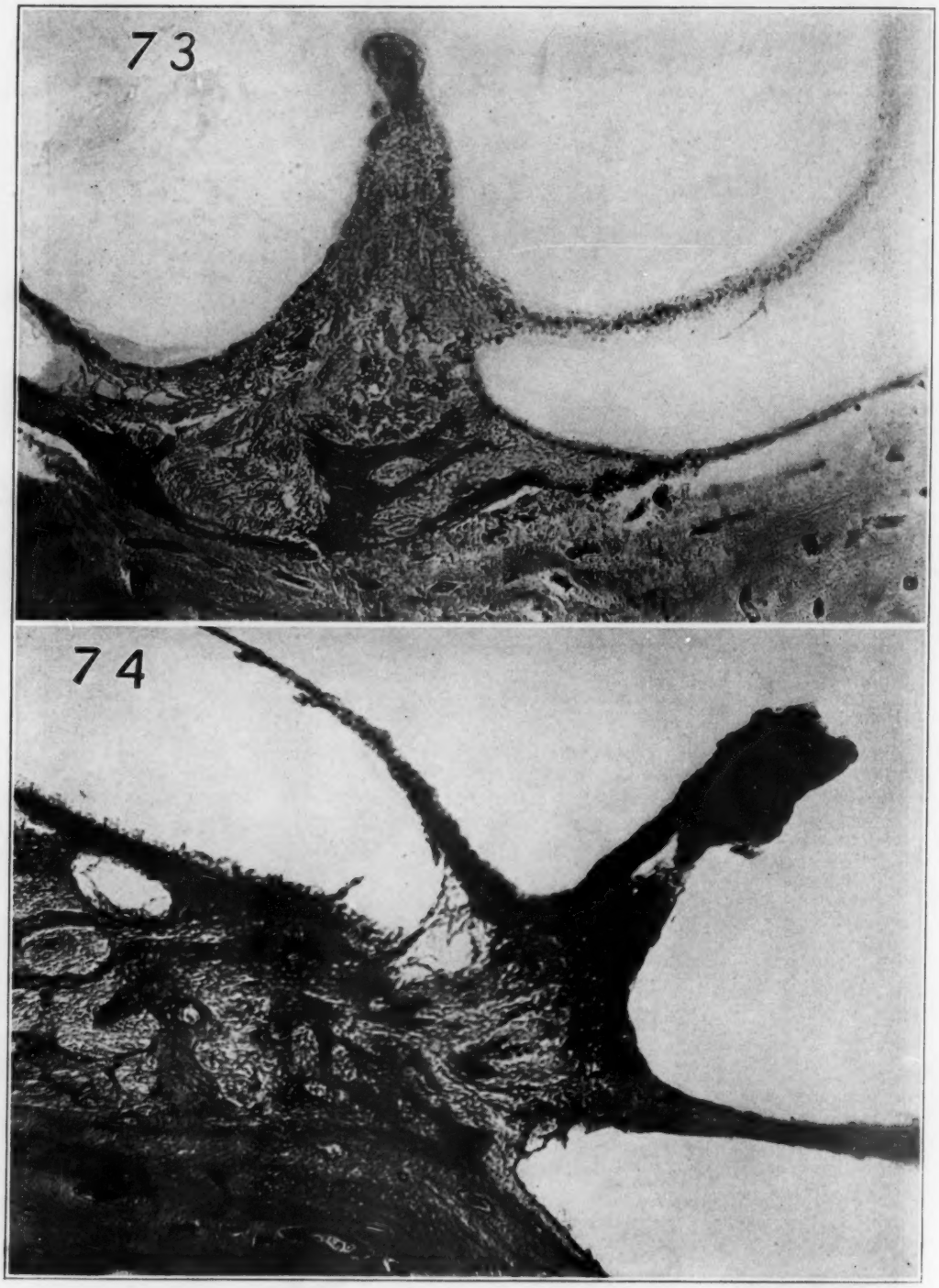


Fig. 73 (H).—Hemorrhages in the nerve cell layer of the ampullar crista. Pigmentations found here may be mistaken for a hemorrhage.

Fig. 74 (H).—Hemorrhagic infiltration and laceration of the entire ampullar crista.

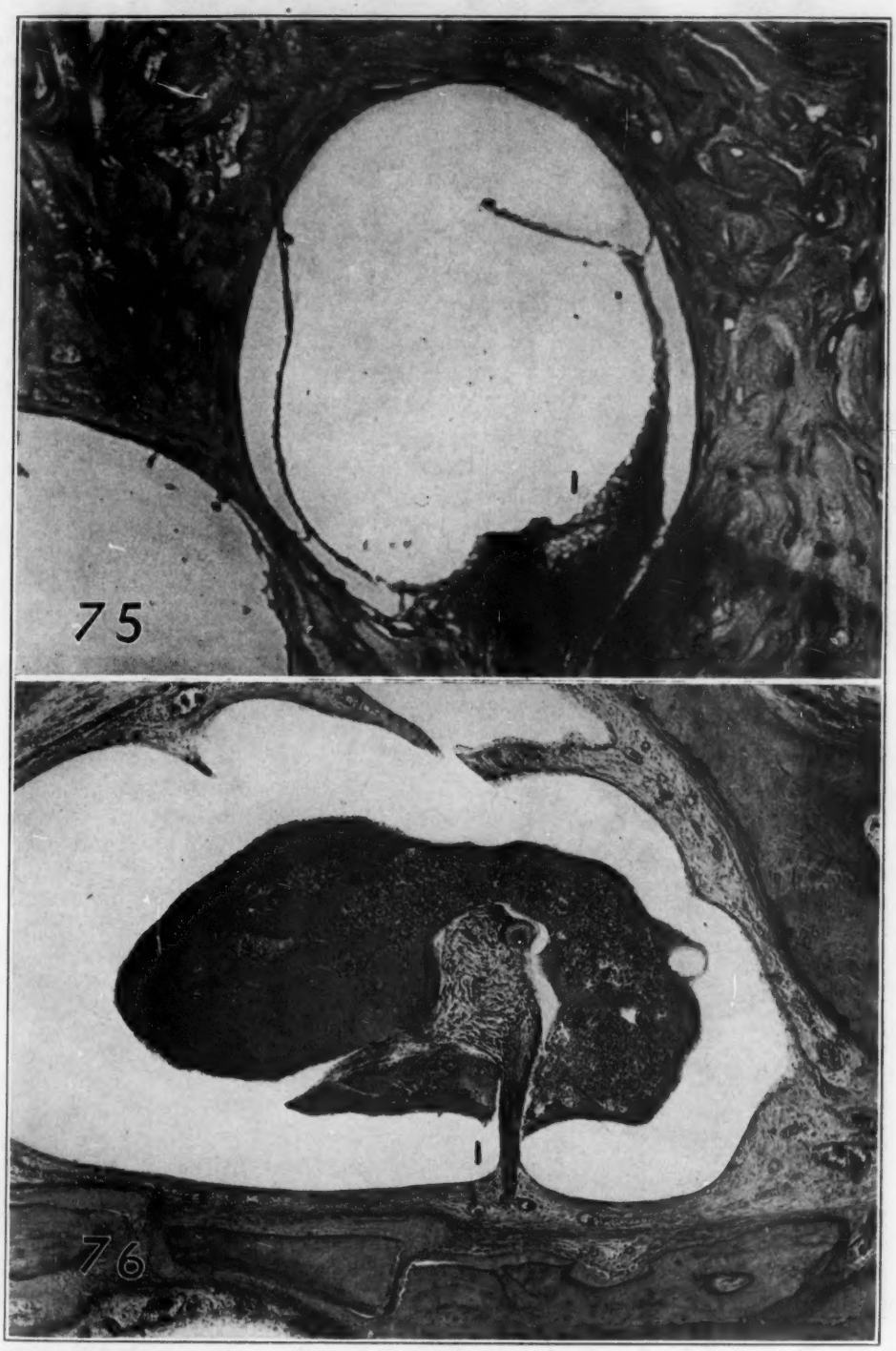


Fig. 75 (H).—Hemorrhagic infiltration in the nerve layer of the macula sacculi (*1*).

Fig. 76 (H).—Perilabyrinthine pneumatic cell. There is beginning resorption of the hemorrhage and exudate by a vascular projection (*1*) originating from the submucosa of the pneumatic cell.

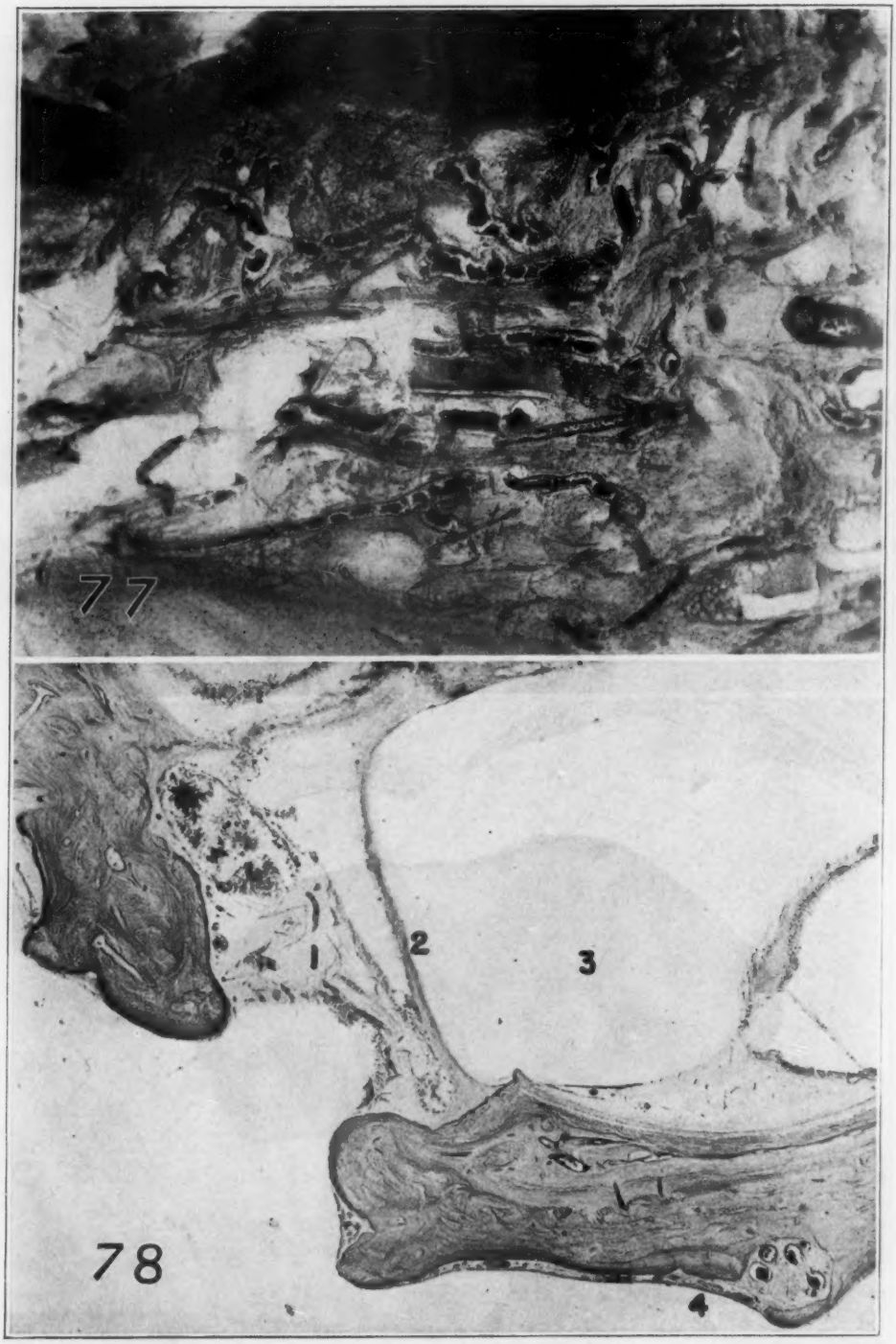


Fig. 77 (H).—Resorption of a thrombus by recanalization. Note the numerous newly formed small vessels without apparent coordination.

Fig. 78 (H).—Resorption of a hemorrhage in the niche of the round window by newly formed small vessels (*1*). Secondary tympanic membrane (*2*). Basal turn of the cochlea (*3*). Hyperemia in the venous plexus around Jacobson's nerve (*4*).

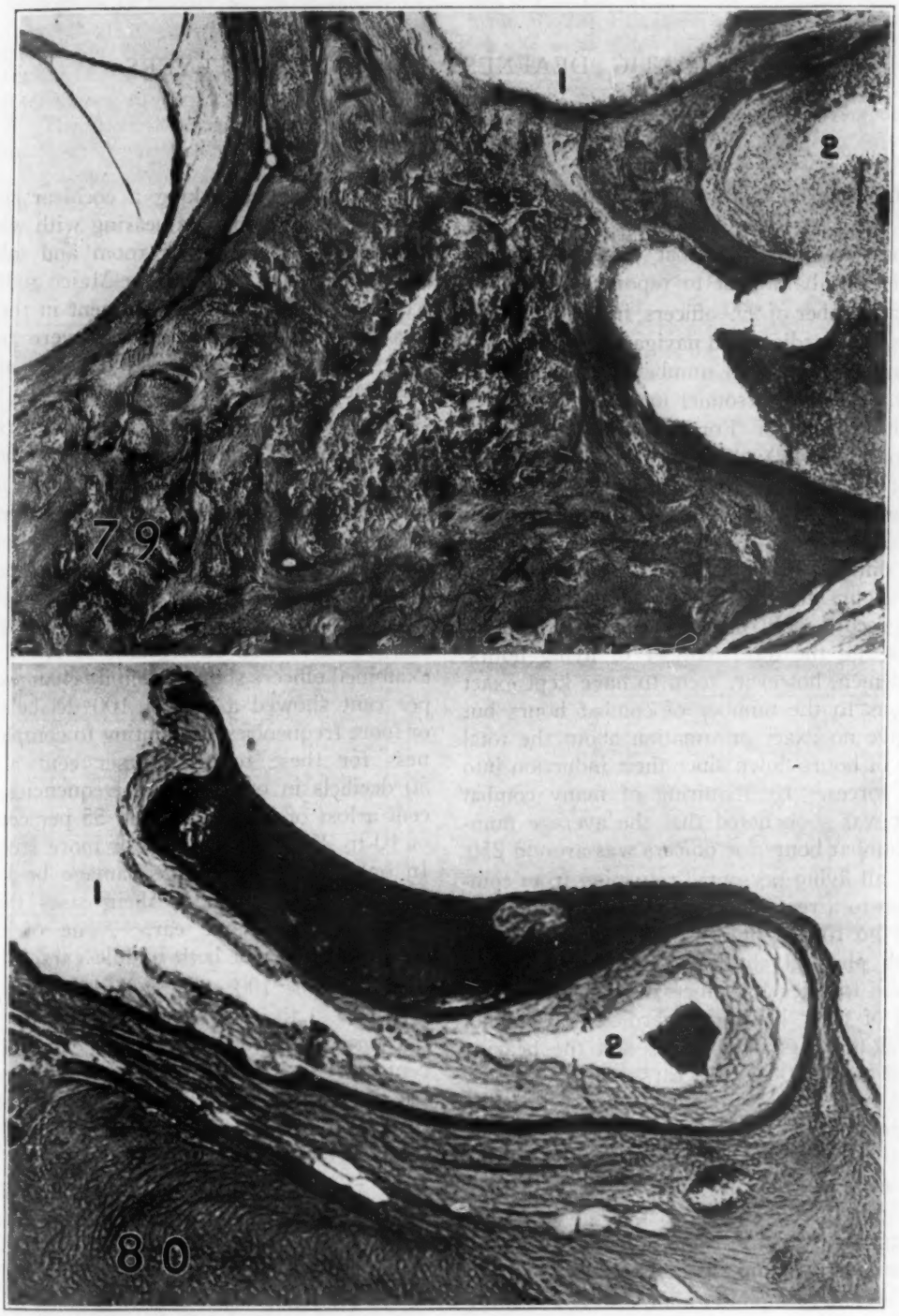


Fig. 79 (V).—Fissure traversing an otosclerotic focus, the latter in a typical location, around the fissula ante fenestram. Oval ligament, partly involved by the otosclerotic process (*1*). Hemorrhage in the tympanic cavity (*2*).

Fig. 80 (H).—Traumatic origin of cholesteatoma. Rupture of the tympanic membrane (*1*). The torn edges are rolled back, enclosing a cystic cavity (*2*); the latter is filled with desquamated epithelial lamellas.

TRAUMATIC DEAFNESS IN COMBAT FLYERS

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The findings in a large number of examinations of the ears done during the past year on flying personnel with combat experience seem to be of enough interest to report.

A total number of 999 officers, including pilots, co-pilots, bombardiers and navigators were examined, as well as a total number of 1,855 aerial gunners. All the personnel included in this report were flyers of Fortresses (B-17's) and Liberators (B-24's). Two officers flew B-18's. None of the officers had less than a total of 400 flying hours. The majority of them had from 600 to 2,500 hours in these ships in the air. It was difficult to obtain the exact number of combat hours for officers since most of them keep a record only of the number of combat missions and the total number of flying hours. Enlisted men, however, seem to have kept exact records as to the number of combat hours but could give no exact information about the total number of hours flown since their induction into the air forces. By inquiring of many combat flyers it was soon noted that the average number of combat hours for officers was around 250.

Since all flying personnel returning from combat zones to a rerouting and reclassification pool have to go to the flight surgeon's office for a thorough physical check-up, the flight surgeon was asked to refer 100 officers for further investigation of their hearing regardless of whether he found the ears undamaged and the hearing recorded as 20/20 in both ears. This was easy because, of 999 officers, only 2 had hearing of the whispered voice of less than 20/20, 20/20. All of these 100 officers were between 20 and 30 years old and had no complaints about their ears on questioning except that of an occasional humming and ringing in one or both ears. The ear drums were in no case traumatized.

As a second group, 40 gunners were examined who shared the same flying history with the officers in that all flew on either B-17's or B-24's (Fortresses and Liberators). They all had an average of 300 combat hours in the air, and all were between 20 and 30 years of age.

The examination consisted of taking a fairly accurate history, inspecting the auditory canal, the drums, the nasal passages, the epipharynx and the pharynx, making a cochlear test with tuning forks, testing the hearing with whispered speech in a sound proof room and taking an audiogram. For the latter the Maico audiometer, accepted as a standard instrument in the Army, was used, and the audiograms were taken by men well trained in making this test and with this instrument.

Accepting the graph for normal hearing outlined in the investigations of C. C. Bunch [1] and neglecting losses of less than 5 decibels in either one of the frequencies, in this series were found only 3 officers whose audiograms showed no damage. These 3 men had been eight months or longer in the combat zone. One had a total of 800, the other 2 had 2,000 and 2,500 flying hours, respectively. The audiograms of 97 of the 100 examined officers showed definite changes. Three per cent showed a loss of 100 decibels in one or more frequencies, amounting to complete deafness for these tones; 27 per cent a loss of 50 decibels in one or more frequencies, 12 per cent a loss of 30 decibels and 55 per cent a loss of 10 to 25 decibels in one or more frequencies. In only 6 men could the damage be traced to the middle ear, and in their cases there was damage only of one ear. None of the men showed damage of both middle ears.

Among the 100 officers of this group 66 per cent had in their audiograms a fatigue notch in one form or the other at frequency 2896; 16 per cent at frequency 4096, and the rest, 18 per cent, had mixed forms of hearing loss in which the original fatigue notch could no longer be distinguished.

In reviewing the audiograms of these men we found that it was not difficult to break them down into certain groups:

In group 1 as represented in audiogram *1* (chart 1) 32 per cent were found to have a notch of no more than 20 decibels at frequency 2896, with no other changes in the curve and with hearing by bone conduction normal. The illustrative audiogram shows a slight depression of from 5 to 10 decibels throughout the curve for the left ear, which is due to the fact that this particular pilot listens to the radio with his left ear. The majority of this group had no more than 500

1. Bunch, C. C.: Conservation of Hearing in Industry, J. A. M. A. **118**:588-593 (Feb. 21) 1942.

flying hours and an average of no more than 150 combat hours. Audiogram *1a* belongs to one of the 16 men mentioned in the previous paragraph and shows findings identical with those reported by Campbell and Hargreaves [2] and other investigators concerning aviators flying lighter planes, such as BT-2, BT-9, B-10, B-18 and B-17. The notch here appears, as reported by these authors, at frequency 4096.

The second group comprises those with from 500 to 1,000 flying hours and at least 300 combat flying hours. Their curves are represented in audiograms *2* and *2a* (chart 2). The loss in this group is anywhere from 30 to 50 decibels in at least one ear, with a notch again at 2896. In many cases the ear with which the radio is used shows the deeper notch. In this group, as in the previous one, there is no marked depression in hearing by bone conduction. The time elapsed between the last flight and the examination is, as noted in most of the audiograms, from two to six weeks.

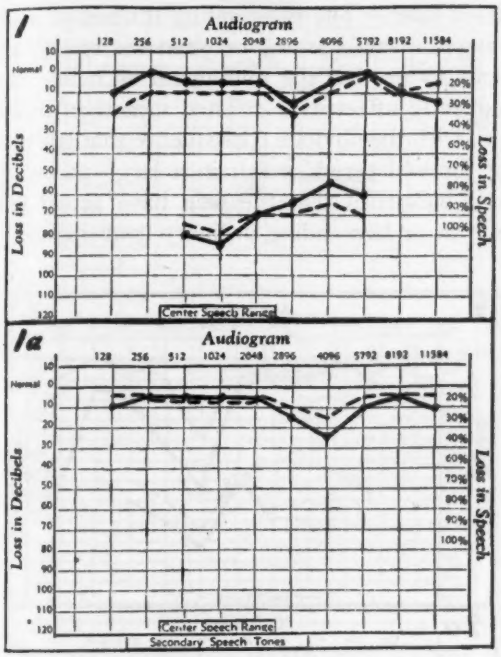

Chart 1.—*1*, audiogram of Lt. R. J., flyer in a B-17, with 450 hours of flying time. He has used his left ear for radio communications. It is two days since his last flight. A fatigue notch appears at 2896. Hearing by bone conduction is normal.

In this and all subsequent audiograms the solid line represents hearing in the right ear and the broken line hearing in the left ear.

The decibel loss in percentage for Lt. R. J. is, right, 5.60 and, left, 8.40; the hearing for whispered voice is 20/20 in both ears.

1A, audiogram of Lt. B. R., flyer in a B-10, with a canopied cockpit. He has 300 hours of flying time. Note the fatigue notch at 4096. The decibel loss of Lt. B. R. in percentage is, right, 6.20 and, left, 5.20. The hearing for whispered voice is 20/20 in both ears.

Group 3 includes men with 1,000 hours in the air and 300 combat flying hours. Here the notch appears again at 2896 with losses of no more than 30 decibels, but the same notch is seen in the hearing by bone conduction. It was found that in the majority of cases hearing by bone conduction is not materially affected in flyers who have less than 1,000 flying hours with a Fortress. See audiograms *3* and *3a* (chart 3).

Group 4 includes flyers with from 1,000 to 1,500 hours in the air, most of whom reveal a more severe damage, forming the borderline of a group with subjective complaints of difficulties in understanding ordinary conversation. The two audiograms of this group presented here (*4* and *4a*, chart 4) concern 2 flyers with approximately 1,500 hours of flying heavy ships. Both audiograms show a deep notch, *4* at 2896 and *4a* at 4096. In both cases the hearing by bone conduction at this frequency is severely depressed, a depression amounting to deafness in the second case. Audiogram *4a* represents an officer who found it difficult to understand women and children.

We had occasion to examine a few, 3 included in the present series and 4 examined for other reasons, who flew 2,000 or more hours in the air in either B-17's or B-24's. Four of these men were test pilots before they entered the Army. It was interesting to note that all of these 7 men had little, if any, change in their audio-

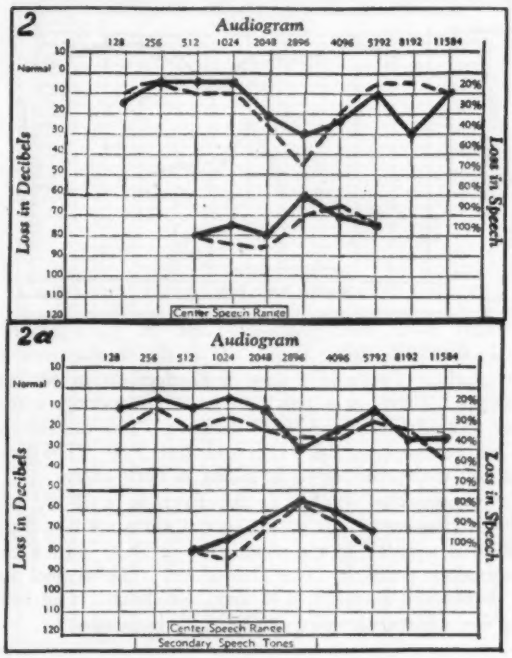

Chart 2.—*2*, audiogram of Lt. C. D., flyer in a B-17, with 500 hours of flying time. He has used his left ear for radio communication. It is one month since his last flight. There is a loss of hearing by air conduction up to 50 decibels. Hearing by bone conduction is normal. The decibel loss in percentage is, right, 12.40 and, left, 11.60. The hearing for whispered voice is 20/20 in both ears.

2a, audiogram of Lt. D. J., flyer in a B-17, with 600 flying hours. His loss by air conduction runs to 30 decibels. Hearing by bone conduction is normal. The decibel loss in percentage is, right, 12.00 and, left, 16.40. The hearing for whispered voice is 20/20 in both ears.

2. Campbell, P. A., and Hargreaves, J.: Aviation Deafness: Acute and Chronic, Arch. Otolaryng. **32**:417-428, (Sept.) 1940.

grams. Two illustrative audiograms pertaining to this small group are presented in chart 5. In the first one there is seen only a small fatigue notch at 2896 and no other disturbance in hearing either by air or by bone conduction.

The second, *5a*, concerned a master sergeant who had been flying for eight years, with 2,500 hours in the air and 350 combat hours, during which he functioned as waist gunner. In his pre-Army time he was a stunt flyer and parachuter. Of all the men flying heavy bombardment planes who were examined at this station, this particular man had the best audiogram. It appears that a man who flies 2,000 hours or over in military, not soundproof planes is resistant to acoustic trauma as well as to other harmful changes in his organism. In other words, he can take it. But there are few of his kind—only 3 or 4 in 100.

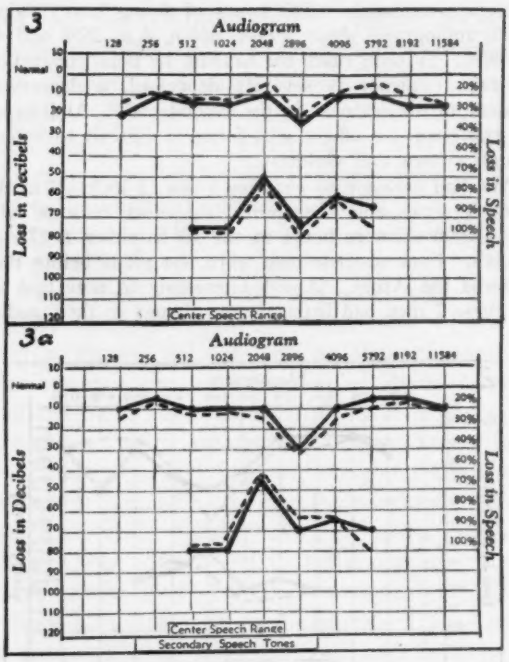

Chart 3.—*3*, audiogram of Capt. R. J., flyer in a B-17, with 970 flying hours. It is six weeks since his last flight. There is a loss of 25 decibels in air conduction. There is a notch in bone conduction with a loss at this frequency of 20 decibels. The decibel loss in percentage is, right, 11.60 and, left, 9.60. The hearing for whispered voice is 20/20 in both ears.

3a, audiogram of Lt. J. A., flyer in a B-17, with 1,000 flying hours. It is one month since his last flight. There is a notch in air conduction at 2896 with a corresponding notch in bone conduction. The decibel loss in percentage is, right, 8.40 and, left, 10.00. The hearing for whispered voice is 20/20 in both ears.

Group 5 includes 15 flyers who showed one or the other of two curves represented in the audiograms shown in charts 6 and 7. Five were found with a steep decline in the curve, beginning at 2048 and reaching down to 90 decibels, with little or no recovery at higher frequencies, and 8 flyers showed a curve in which the decrease begins at 1024 and gradually declines throughout the high frequencies. These curves were recorded for flyers with 550 to 1,100 hours in the air.

The second party examined were enlisted men. Out of a group of 1,855 gunners returning from combat duty 40 men were selected at random and submitted to a thorough otolaryngologic examination. In reviewing the audiograms of this group it is apparent that the percentage of men damaged in their hearing at any frequency more than 50 decibels is much higher than that of officers. Whereas among the officers 30 per cent had losses of more than 50 decibels, the ratio among the enlisted personnel was 60 per cent. The possible reasons for this will be discussed later. The outstanding difference in the changes in audiograms between the two groups seems to be that the middle ear is much more frequently affected in enlisted men than in officers, with the obvious consequence that the hearing for whispered speech in a large percentage is so weakened that the men have actual difficulty in understanding ordinary conversation.

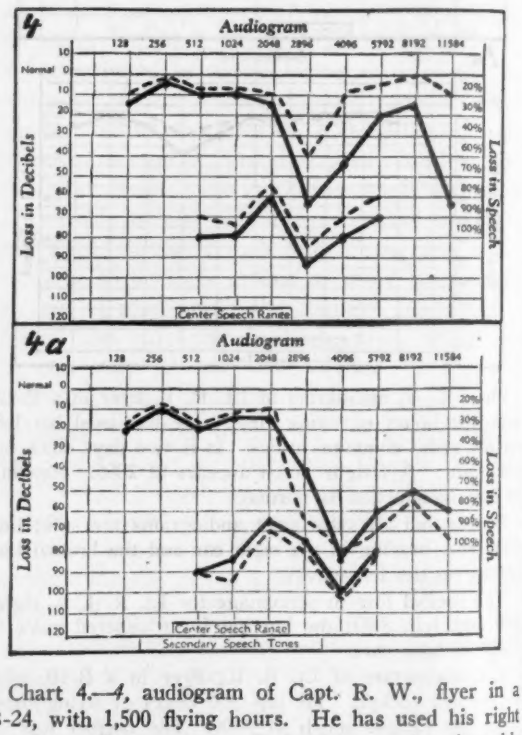

Chart 4.—*4*, audiogram of Capt. R. W., flyer in a B-24, with 1,500 flying hours. He has used his right ear for radio messages. It is three weeks since his last flight. There is a loss of up to 70 decibels in hearing by air conduction, with a corresponding loss in hearing by bone conduction. The decibel loss in percentage is, right, 21.20 and, left, 8.80. The hearing for whispered voice is 20/20 in both ears.

4a, audiogram of Lt. W. C., flyer in a B-17, with 1,450 flying hours. He has been flying for eight years. There is a loss of 90 decibels. Hearing by bone conduction is depressed throughout the curve. The decibel loss in percentage is, right, 30 and, left, 33.60. The hearing for whispered voice is, right, 20/20 and, left, 18/20.

Audiogram *8* (chart 8) concerns a waist gunner with 1,200 hours' flying in a B-17. The audiometric curve is depressed all the way through, with a loss up to 90 decibels at frequency 2896. Hearing by bone conduction is practically gone. At examination the man showed a large cushion of adenoids narrowing the entrance to the eustachian tubes.

Audiogram *8a* is that of a gunner with 1,100 flying hours in a B-17. He claimed to have been deafened during a parachute jump from 18,000 feet (about 5,500 meters).

Audiogram *9* (chart 9) is that of a sergeant with 300 combat hours as tail gunner in a B-24. He also

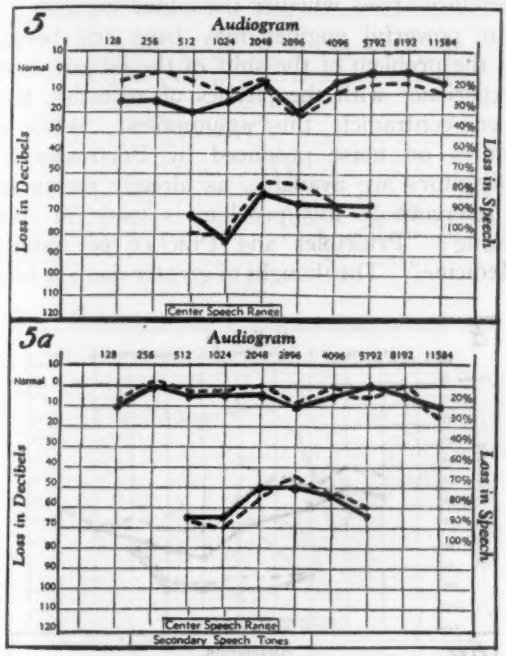

Chart 5.—*5*, audiogram of Major L. B., flyer in a B-17, with 2,000 hours of flying time. He has used his left ear for radio communications. It is one month since his last flight. There is a small fatigue notch at 2896. Otherwise the audiogram is normal. The decibel loss in percentage is, right, 8.00 and, left, 6.00. The hearing for whispered voice is 20/20 in both ears.

5a, audiogram of Sgt. J. M., waist gunner in a B-24, with 2,500 flying hours and 350 combat hours. He had been a stunt flyer and parachuter. He had the most normal audiogram with the smallest fatigue notch of 140 examined flyers engaged in heavy bombardment. The decibel loss in percentage is, right, 4.40 and, left, 4.00. The hearing by whispered voice is 20/20 in both ears.

feels that his hearing was somewhat damaged during a parachute jump from 20,000 feet (about 6,100 meters). On examination he was found to suffer from a deviated septum.

Audiogram *9a* concerned a sergeant with 900 hours in the air in a B-24 and 300 combat hours. He claimed to have been deafened during a prolonged machine gun battle in the air which lasted over an hour, during which he was wounded in the face.

Audiograms *10* and *10a* (chart 10) belong to two men with a special history behind them. Both enlisted in the Army on the same day, went through the same training, had 600 flying hours and 50 combat hours, all the while flying on the same B-17, one as left and the other one as right waist gunner. During a battle over enemy territory in Europe, the plane was afire, and the whole crew had to bail out in a hurry from 24,000 feet (about 7,300 meters). Neither man had time to use his oxygen equipment. The man of audiogram *10a* suffered considerable damage as seen from the illustration. The man of audiogram *10* suffered little damage. All his audiogram shows is a fatigue notch at 2896; yet he has suffered all his life from severe hay fever and exhibited a noticeable attack of it during the examination.

COMMENT

The first question that arises in the mind of one who is familiar with previous investigations of others is the fact that in so large a percentage of these combat flyers who have engaged in heavy bombardment the fatigue notch appears at frequency 2896 instead of at frequency 4096 as reported by other authors concerning flyers with other planes. In this series of examinations the depression appears one-half octave lower than

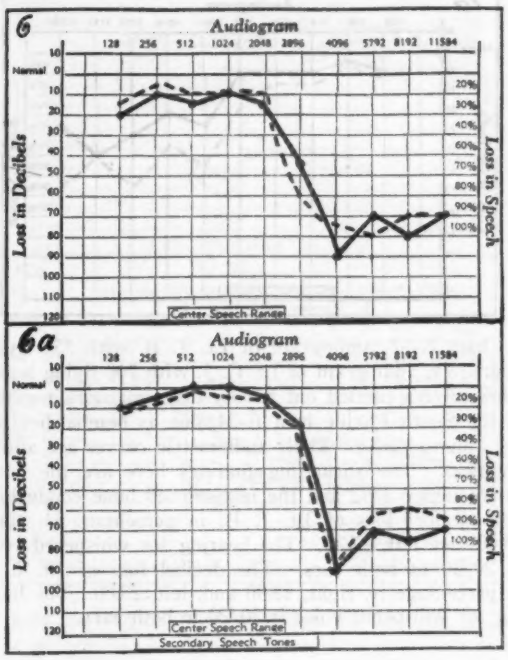

Chart 6.—*6*, audiogram of Lt. C. M., flyer in a B-24, with 550 hours of flying time. It is one month since his last flight. The curve shows hearing damaged from frequency 2048 on, without recovery. The decibel loss in percentage is, right, 36.00 and, left, 32.40. The hearing for whispered voice is 20/20 in both ears.

6a, audiogram of Capt. W. G., flyer in a B-24, with 1,100 flying hours. It is one month since his last flight. The decibel loss in percentage is, right, 27.60 and, left, 26.00. The hearing for whispered voice is 20/20 in both ears.

Both these officers belong in the group of 15 per cent whose hearing was damaged in any frequency more than 50 decibels.

that ordinarily reported for aviators and industrial workers. Definite data on the noise frequencies produced by the motors and propellers of B-17's and B-24's could not be ascertained, but it seems reasonable to assume that the motors of heavy bombardment planes follow with some deviation the same experienced rules of other large planes. The compound noise here, as in other planes, is the sum of engine explosion, propeller hum, sounds from slip stream effects on wings and sounds of other moving parts,

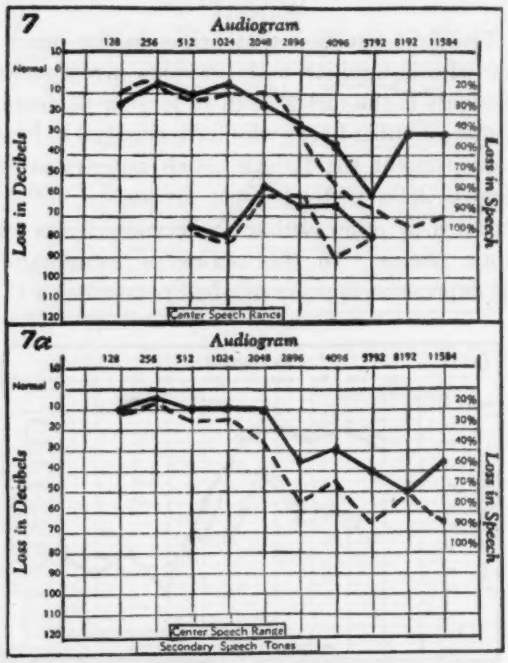

Chart 7.—*7*, audiogram of Lt. J. B. with 550 flying hours; *7a*, audiogram of Lt. C. J. with 700 flying hours. These flyers carried out twenty-three missions together in the South Pacific in a B-24, one as bombardier and the other as pilot. Their audiometric curves are almost identical. The surprising findings here are the notch at frequency 5792 and the undisturbed bone conduction. The decibel loss of Lt. J. B. in percentage is, right, 18.40 and, left, 27.20. The hearing for whispered voice is 20/20 in both ears. The decibel loss of Lt. C. J. in percentage is, right, 18.80 and, left, 28.00. The hearing for whispered voice is 20/20 in both ears.

to which have to be added vibrations of various frequencies and their overtones. The intensities of these sounds have been measured and recorded by aircraft engineers as lying between 80 decibels in soundproofed planes and somewhere between 110 and 130 decibels in open cockpit and combat planes. Armstrong [3] recorded the sound frequencies of the audible ranges in airplanes and found them lying for the most part under 1,000 double vibrations per second. The greatest intensities lie between 100 and 500 double vibrations per second. These figures vary with each type of plane and the number of motors; the four-motored Fortresses and Liberators likely have somewhat different ranges as compared with the smaller and older planes examined by Armstrong. In addition one has to consider the constant listening for radio messages through ear phones. Armstrong's examinations refer to planes with one and two engines. The question therefore arises whether the added intensities of four powerful engines may have any bearing on the problem of the shift of the fatigue notch. Experience with the physics of acoustics, however, contradicts this assumption. While no figures on noise produced by Fortresses and Liberators are available, as already mentioned, a reference to this problem is made in Armstrong's "Principles and Practice of Aviation Medicine." The thought of greater damage being

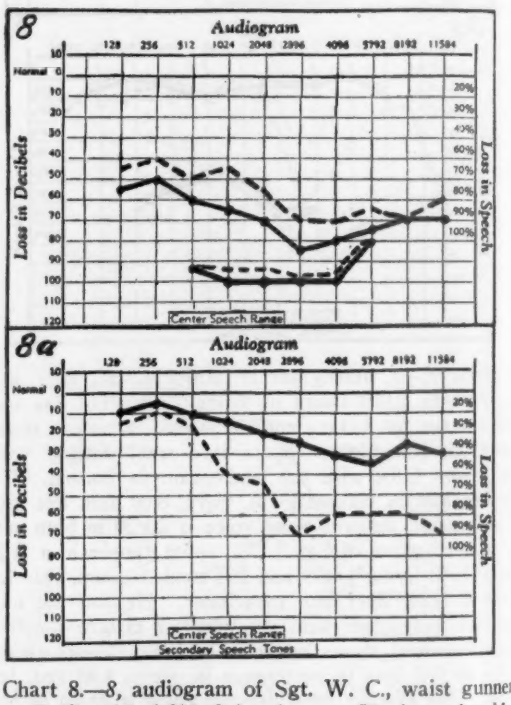

Chart 8.—*8*, audiogram of Sgt. W. C., waist gunner in a B-17, with 1,200 flying hours. He has adenoids. It has been one month since his last flight. Hearing by both air and bone conduction is considerably depressed; there is practically complete loss of hearing by bone conduction. *8a*, audiogram of Sgt. S. M., 36 years old, flyer in a B-17, with 1,100 flying hours. He noted deafness in the left ear after a parachute jump from 18,000 feet (about 5,500 meters). Both men are hard of hearing. The decibel loss of Sgt. W. C. in percentage is, right, 54.40 and, left, 45.60. The hearing for whispered voice is 10/20 in the right and 12/20 in the left ear. The decibel loss of Sgt. S. M. in percentage is, right, 16.40 and, left, 35.60. The hearing for whispered voice is 20/20 in the right and 8/20 in the left ear.

3. Armstrong, H. G.: Principles and Practice of Aviation Medicine, Baltimore, Williams & Wilkins Company, 1939, pp. 193-198.

done by louder noise is there illustrated in the figures given for aircraft in general.

Aircraft noises in general originate from the propeller tips and the engine exhaust. The propeller is the source of an intense sound, the exact acoustics of which are as yet not fully understood. It is known, however, that when the speed of the propeller tips reaches a sound intensity somewhere between seven-tenths and one times the speed of sound the sound intensity is greatly increased. Thus the only method

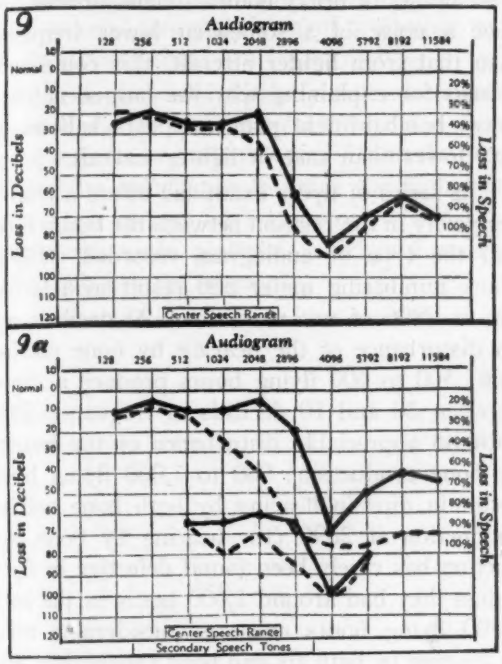

Chart 9.—*9*, audiogram of Sgt. R. W., with 300 combat hours as tail gunner in a B-24. He has made one parachute jump from 20,000 feet (about 6,100 meters). He has a deviated septum. The decibel loss in percentage is, right, 36.80 and, left, 39.60. The hearing for whispered voice is 16/20 in both ears.

9a, audiogram of Sgt. E. R., waist gunner in a B-24, with 900 flying hours and 300 combat hours. He thinks he lost hearing during a prolonged machine gun battle on one mission. The decibel loss in percentage is, right, 21.20 and, left, 36.00. The hearing for whispered voice is 20/20 in the right and 16/20 in the left ear.

known to reduce the propeller noise is to reduce the speed of the propeller tips, which in turn would react on the speed of the plane. The noise of the exhaust depends on the number of cylinders, the rotations per minute and the length of the exhaust. All engine mufflers devised up to this time have been found to be unworkable, and therefore all efforts to reduce airplane noise materially have remained fruitless.

Armstrong mentioned in this connection that unless both of these sources of noise can be reduced simultaneously, little benefit will result. This is based on the fact that if several noises arrive at the same point with equal intensity, the level of the combined noises will be only a few decibels above that of any one component. For instance, if the engine and the propeller each make the same noise, the two together do not make twice the noise which either one makes alone but an amount only about 3 decibels louder. Thus if the engine exhaust and the propeller together make a sound equal to 120 decibels, complete elimination of the sound from the exhaust reduces the noise level to only 117 decibels.

The same rule, of course, holds for multiple engines. The fact that Fortresses have four engines does not multiply the sound intensity four times but increases it by only a small fraction of the sound level of one. I feel justified, therefore, in discarding the added noise of the four engines as a factor in the shifting of the fatigue notch.

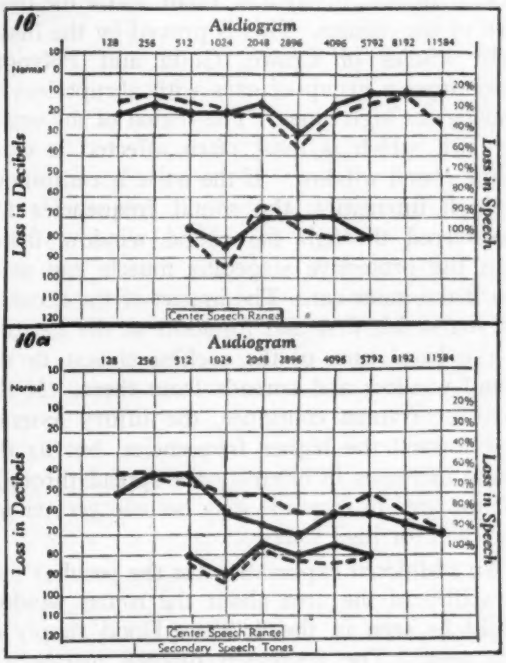

Chart 10.—*10*, audiogram of Sgt. F. W.; *10a*, audiogram of Sgt. G. A. Both men enlisted in the army on the same day, went through the same training, flew the same B-17, one as left and the other as right waist gunner, and had 600 flying hours and 50 combat hours. Both bailed out during the same mission over enemy territory from 24,000 feet (about 7,300 meters) while the plane was afire, and had no time to use oxygen equipment. Both escaped together to England. The one whose audiogram (*10*) indicates little damage has suffered all his life from hay fever. The decibel loss of Sgt. F. W. in percentage is, right 13.20 and, left, 14.80. The hearing for whispered voice is 20/20 in both ears. The decibel loss of Sgt. G. A. in percentage is, right, 46.40 and, left, 42.00. The hearing for whispered voice is 14/20 in the right and 16/20 in the left ear.

As another source for this shift I suspected an error in the calibration of the audiometer for recording the notch at this lower frequency. The audiometer was checked, and the notch again appeared with surprising regularity at 2896. I can therefore offer no explanations other than those generally accepted concerning the vulnerability for C^5.

For the benefit of those not immediately familiar with the literature, the theories may be briefly repeated here. It is generally assumed that the reason for this circumscribed defect in hearing is identical whether the acoustic trauma follows exposure to a sudden blast or results from repeated or continued exposure to loud sounds (noise). The ear is unprotected against sudden noise during the short time of from five to ten milliseconds before the tensor tympani and the stapedius muscle can contract. In both forms of acoustic trauma the damage is found to be located approximately 2 to 3 mm. above the basal turn of the cochlea. This is proved by the histologic studies of Crowe, Guild and Polvogt [4] concerning a group of ears with abrupt loss of hearing for high tones. The region of the organ of Corti which is most often affected is close to the round window. If the noise is continuous at high intensities, the sound frequencies are transferred through the round window faster than the protective stapedius muscle can safeguard the inner ear. The impact of the acoustic trauma is felt first and foremost at the location of the basal turn of the cochlea closest to the round window and spreads from there. If the noise or trauma continues, the injury extends first toward the higher frequencies, but as the sound increases in intensity the spread throughout the area of response may become greater for low than for high tones.

An additional explanation for the peculiar vulnerability of the area about the round window might be seen in the deficient blood supply of this area. The decreased oxygen metabolism of the area in the presence of the poor supply of oxygen would make the region more susceptible to fatigue. While the oxygen concentration in atmospheric air remains constant up to 72,000 feet (about 22,000 meters), the decrease in barometric pressure with altitude causes a decrease in the partial pressure at which the oxygen is made available to the body. With each 1,000 feet (about 305 meters) of altitude the breathing of tissues is markedly decreased until at around 14,000 feet (about 4,300 meters) it reaches a critical level unless the body is supplied with oxygen from artificial sources.

Perlman [5] subjected persons to fatiguing tones of a pure quality. He found that the maximum dip caused by fatigue appeared one octave above the frequency of the fatiguing tone and discovered this to be true for cycles 512, 1024, 2048 and 4096 cycles. The results were not uniform for 256 cycles. These findings have so far not been confirmed, but if confirmed they will help explain the shift in the notch. If the high-powered motors of heavy bombardment aircraft produce a noise of a somewhat lower frequency than that from lighter aircraft, this could form a basis for explaining why the fatigue notch in heavy bombardment planes appears half an octave lower than that in lighter aircraft.

The series of flyers examined offers a relative regularity in the relation between the hours flown and the type of audiogram recorded. Flying hours numbering under 500 result in a fatigue dip at 2896 of not more than 20 decibels and no disturbance of the hearing by bone conduction; 500 to 600 flying hours produce a dip of between 30 and 50 decibels at frequency 2896, with no appreciable disturbance of the hearing by bone conduction; 900 to 1,000 flying hours result in dips in hearing by both bone and air conduction at 2896 (the hearing by bone conduction has rarely been found defective in flyers unless they had around 1,000 hours in the air); 1,500 flying hours cause a considerable notch in hearing by both air and bone conduction, with hearing by the latter abolished at the dip. On the other hand, men who have the physical stamina to fly 2,000 or more hours in the air may or may not show a fatigue dip of from 10 to 20 decibels but are otherwise unaffected in their hearing. I believe that this series of examinations enabled me to draw the foregoing conclusions concerning the relationship of flying hours to the type of acoustic trauma as suffered by flyers piloting heavy bombers.

The reasons for the larger percentage with acoustic trauma among enlisted men (gunners) seem to point in two directions: First, the sifting by physical examinations before men enter flying schools is apparently less accurately done with them than with officers. Otherwise there would not have been found a rather high percentage with nasal disturbances, treatment of which, if applied in time, could possibly have saved the hearing of some of the gunners. It is apparent

4. Crowe, S. J.; Guild, S. R., and Polvogt, L. M.: Pathology of High Tone Deafness, Bull. Johns Hopkins Hosp. **54**:315-379, 1934.

5. Perlman, H. B.: Acoustic Trauma in Man: Clinical and Experimental Studies, Arch. Otolaryng. **34**: 429-452 (Sept.) 1941.

from the audiograms of these men that much of the damage has been due to obstruction or the inability to ventilate the eustachian tubes during rapid descent or parachuting. Evidence of damage of the middle ear was conspicuously absent in the audiogram of officers.

Second, the graver acoustic trauma in gunners may be attributed to their handling machine guns during practice and battle, firing the guns much oftener and for longer period than the officers occupied with piloting, navigating and serving the bomb sight. That the additional trauma from long and frequent firing of a machine gun will leave scars there can be no doubt.

The problem most frequently discussed among personnel was the disposition of those flyers showing appreciable acoustic trauma. Up to the present time, no regulations to guide the flight surgeon in this respect have come out of the War Department, since material sufficiently studied is probably not yet at hand.

SUMMARY

A series of 100 officers and 40 enlisted men out of a large material of flyers flying Fortresses and Liberators were examined for acoustic trauma after they returned from combat.

Among the officers 30 per cent were found with an audiometric deficiency of more than 50 decibels in at least one frequency.

Among the enlisted men, who were all gunners, the percentage with damage of more than 50 decibels in at least one frequency was 60 per cent.

The fatigue notch appeared at frequency 2896 in 66 per cent of all examined men.

For a majority a definite relationship between the amount of damage to hearing as shown in audiograms and the number of hours flown in these heavy ships could be demonstrated.

Captain Joseph M. Cronin, flight surgeon, cooperated in making this study possible. Sergeant Adalbert G. Rawald and Corporal Blanton F. Cogburn took the audiograms.

COMPLICATIONS OF OTITIS MEDIA AND THEIR TREATMENT

COMMANDER E. E. KOEBBE (MC), U.S.N.R.
AND
LIEUTENANT COMMANDER J. J. POTTER (MC), U.S.N.R.

A survey of recent cases of infection of the ear at a United States Naval Hospital revealed an unusual incidence of complications. Their clinical course and response to treatment will be reviewed.

The following data were obtained from the Eye, Ear, Nose and Throat Service. They cover a period from Nov. 1, 1943 until May 15, 1944. During this time there was an average daily census of 380. More than one half of these patients had acute aural infections. The hospital was the receiving station for the entire Naval District. Many patients with surgical mastoiditis, often with grave complications, were admitted as such.

During this period 170 mastoidectomies were performed. The otitic complications encountered are listed in table 1.

TABLE 1.—*Complications of Otitis Media*

	Cases	Percentage with Recovery
Meningitis	20	100
Thrombosis of a lateral sinus	14	100
Subperiostial abscess and Bezold's abscess	10	100
Encephalitis	6	100
Abscess of the brain	3	33.3*
Paresis of the 7th nerve	6	100
Paresis of the 6th nerve	3	100
Suppurative labyrinthitis	1	100
Petrositis	1	0*

* One patient who died had cerebellar abscess and petrositis.

OTITIC MENINGITIS—20 CASES

In the cases of otitic meningitis the leukocyte counts on the spinal fluid varied from 600 to 17,000 cells. In 7 cases virulent micro-organisms were grown from the spinal fluid; i. e., Streptococcus haemolyticus in 5, Pneumococcus in 1 and Streptococcus viridans in 1.

In most of the cases the aural infection had been present three to five weeks at the time meningitis developed. However, in 4 this complication developed from three to five days after the onset of acute otitis media.

The treatment of otitic meningitis varied with the severity of the disease and the previous response of the patient to sulfonamide drugs.

The clinical course of 1 patient and his treatment will be described in detail as typical of the group:

C. A. was admitted, acutely ill, and shortly thereafter became comatose. He had a history of an acute infection of the left ear with intermittent drainage for two months, chills and fever for one week, and vomiting and headache for two days. On admission there was copious discharge from the ear with marked edema and tenderness over the mastoid process. Roentgenograms taken on admission showed clouding of the mastoid process with some destruction of the cells in this bone.

The case was further complicated on the sixth day after admission by aspiration pneumonia. Also, during the course of the disease, fairly widespread encephalitis was evidenced by unconsciousness, frequent convulsions and aphasia.

The increase in the spinal fluid cell count for a day or two following the initiation of penicillin therapy was typical of these cases of otitic meningitis. After the meningitis was well under control, mastoidectomy was done. Much necrosis of cells was found throughout the mastoid process.

As shown in table 2, both penicillin and sodium sulfadiazine were used at first. In several cases in which sulfonamide compounds were not indicated because of previous toxic reactions, penicillin [1] alone was used successfully by intrathecal and intramuscular injection, but the response was not quite as rapid as when the two drugs were used in combination.

In those patients in whom surgical mastoiditis was not present at the time meningitis developed, the response to penicillin was much more prompt. This was particularly true in 4 patients in whom meningitis developed after three days of otitis media.

It was found that in cases of otitic meningitis the treatment with penicillin had to be continued from ten to twenty days in order to prevent relapses, and particularly until after the operation for those requiring surgical treatment.

All the patients operated on withstood surgical intervention well and had a short and uneventful postoperative convalescence.

All patients recovered, and no sequelae were present at the time of discharge from the hospital.

With the use of sulfonamide drugs the recovery rate in otitic meningitis rose strikingly. In the series of Williams and his co-workers [2] it rose from 35 to 69 per cent. With the addition of penicillin to therapy even better results can be expected.

1. Bumed News Letter **3**:15-26 (Jan.) 1944.
2. Williams, H. L., and others: Otitic Meningitis, Laryngoscope **52**:835-869 (Nov.) 1942.

TABLE 2.—*Clinical Data on Patient C. A., Admitted Feb. 18, 1944*

TABLE 2.—*Clinical Data on Patient C. A., Admitted Feb. 18, 1944*

Date	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	2/29	3/1	3/2
Highest daily temperature	104 F.	105.6 F. Chill	104.6 F.	101.2 F.	103.6 F.	103.4 F.	105.6 F.	101 F.	100 F.	101.2 F.	102.8 F.	103.2 F. (Postoperative)	100 F.	99.6 F.
Rigidity of neck	Slight (+ —)	3+	4+	4+	4+	4+	4+	4+	4+	2+	2+	1+	0	0
Mental status	Severely ill, answers questions	Semi-comatose	Comatose	Same	Same	Same	Same	Recognizes people; can't talk	Tries to talk	Talks	.....	.....	Good	Normal
Convulsions	.....	.....	.....	Few	Frequent	Frequent	Frequent	Few	Few	None	None	None		
Spinal fluid	41 cells	3,050 cells	8,200 cells	3,550 cells	700 cells	.....	390 cells							
White blood cells	24,000	.....	15,700	.....	.....	.....	11,050	.....	.....	.....	12,000			
Red blood cells	4,200,000	.....	3,640,000	.....	.....	.....	2,820,000	.....	.....	.....	4,030,000			
Hemoglobin	71%	.....	68%	.....	.....	.....	58%	.....	.....	.....	81%			
Penicillin by intrathecal injection	15,000 units in 15 cc. isotonic solution of sodium chloride	Same	Same	Same	Same									
Penicillin by intramuscular injection	15,000 units every 3 hr.	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Penicillin continued to be given in small doses to 3/10
Sodium sulfadiazine by intravenous injection	5 Gm. on admission													
Sodium sulfadiazine by intramuscular injection	3 Gm. every 6 hr.	Same	Same	Same	Same	Same								
Fluids (intravenous)	A.M. 1,000 cc. 5% dextrose in solution of NaCl; noon, 1,000 cc. sixth-molar lactate; p.m., 1,000 cc. 10% dextrose in water	Same	Same	Same	Same	Same	Same; transfusion	Same	Same	Same; transfusion				
Otorrhea	3+	3+	3+	3+	3+	3+	2+	2+	2+ mastoid 2+ tender	1+ mastoid 2+ tender	1+ mastoid 2+ tender	1+ mastoid-ectomy		
Miscellaneous data	.....	.....	.....	.....	Sodium amytal given intravenously for convulsions	Same; mucus aspirated from pharynx; bladder catheterized	Same; aspiration pneumonia aspiration of mucus; bladder catheterized	Same; greenish sputum expectorated; bladder catheterized		.....	.....	Hemolytic staphylococcus isolated from the mastoid		

THROMBOSIS OF THE LATERAL SINUS—14 CASES

In 2 cases thrombosis of the lateral sinus followed scarlet fever and in 2 it followed measles. The diagnosis was not made without the finding of a definite clot at the time of operation or a positive blood culture or both. In 6 cases Str. haemolyticus, and in 1 case Str. viridans, was grown from the blood culture.

The differential diagnosis between thrombosis of the lateral sinus, atypical pneumonia and a febrile reaction to the sulfonamide compound used was often difficult.

The clinical courses were not infrequently atypical, probably owing to the fact that the patients had received courses of treatment with sulfonamide compounds or penicillin. A few had no chills and showed a low grade rather than a septic type of fever. This also probably accounted for the fact that 4 patients had thrombosis involving the entire lateral sinus from the jugular bulb to the torcular Herophili. In no case was the jugular vein ligated.

When thrombosis of the lateral sinus was suspected, no chemotherapy was used until the diagnosis had been established. The day before the operation 15,000 units of penicillin was given intramuscularly every three hours and this therapy was continued for from seven to fourteen days. In each case the temperature was normal twenty-four to thirty-six hours after the operation and remained normal until convalescence was completed. All patients recovered.

As with otitic meningitis, the use of sulfonamide drugs greatly reduced the mortality rate. In the series of children observed by Hartmann and his co-workers [3] the rate dropped from between 25 and 35 per cent to 10 per cent. Penicillin therapy promises even better results, and especially in those cases which react poorly to treatment with sulfonamide compounds.

OTITIC ENCEPHALITIS—6 CASES

In our series, encephalitis had to be differentiated from meningitis or from abscess of the brain.

The chief symptoms on admission were chills, hectic fever, vomiting and severe headache. This was followed by loss of consciousness, accompanied by frequent generalized convulsions. Four of the 6 patients had definite motor aphasia and a positive Babinski sign on regaining consciousness.

The neck was not rigid but usually had slight limitation of motion. The spinal fluid count varied between 0 and 100 cells, the majority of which were lymphocytes.

The treatment was the same as that of meningitis except that penicillin was not given intrathecally. All patients recovered, and there were no sequelae present at the time of discharge from the hospital.

FACIAL PARALYSIS—6 CASES

When facial paralysis occurred as a complication it usually occurred late in the disease and was often associated with other complications such as encephalitis, involvement of the sixth nerve or labyrinthitis. Function returned following mastoidectomy in all cases.

ABSCESS OF THE BRAIN—3 CASES

Abscess of the temporal lobe occurred as a complication of 1 case. It followed scarlet fever and measles. Recovery was uneventful after surgical drainage and a combination of sulfadiazine and penicillin therapy.

Cerebellar abscess was encountered in 2 cases. In both the abscess was far advanced. The first patient died ten hours after admission. At necropsy there was a large abscess involving the entire interior of the petrous apex, as well as a cerebellar abscess the size of a walnut.

The second patient, who probably had a cerebellar abscess, died suddenly with central respiratory failure. Permission for necropsy was not obtained.

SUPPURATIVE LABYRINTHITIS—1 CASE

The labyrinthitis occurred during the course of severe scarlet fever and was associated with acute pansinusitis and orbital edema. Treatment was by intramuscular injection of penicillin until the acute phase was over, then mastoidectomy. There was marked residual loss of hearing after convalescence.

SUMMARY

During the winter of 1943-1944 an unusual incidence of otitic complications was encountered.

From the results obtained, penicillin therapy promises to become an effective adjunct to the usual treatment. In this series it was particularly effective against meningitis, thrombosis of the lateral sinus and encephalitis.

Unfavorable reactions to penicillin were not encountered.

3. Hartmann, A. F.; Wolff, D., and Love, F. M.: Diagnosis and Management of Severe Infections in Infants and Children, J. Pediat. **21**:435-474 (Oct.) 1942.

LYMPHANGITIS OF THE RETROPHARYNGEAL LYMPHATIC SYSTEM

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During the development of the embryo certain anlages tend to carry with them to maturity some of the more important collateral systems which are destined to provide the mature parts with some of their most important physiologic functions. This tendency is noted particularly in the nerve supply of the muscles derived from the branchial arches. The trigeminal nerve supplies the muscles derived from the first branchial arch, the facial nerve supplies the muscles derived from the second branchial arch, while the glossopharyngeal and the vagus nerves innervate those derived from the third and fourth branchial arches. A good example of this is the derivation of the tensor tympani muscle from the first branchial arch and its innervation by the trigeminal, while the nearby stapedius muscle is derived from the second arch and is innervated by the facial nerve.[1]

The best example of this developmental principle found in the lymphatic system is in the structures derived from the first branchial pouch. The tympanum, the eustachian tube, the adenoid, the paranasal sinuses, the nasal cavities and the nasal septum are derived from this pouch, and the lymph from these structures drains principally into the retropharyngeal and to some extent into the subdigastric nodes (primary echelon) and from these into the deep cervical nodes (secondary echelon).[2]

The retropharyngeal lymphatic system consists of the primary echelon of nodes and the lymph bed, which is present in the mucosa of the structures which drain into them. Pathologic processes which affect either the lymph nodes or the lymph bed usually affect the other, but for convenience the following order of discussion is suggested.

DISEASE OF THE RETROPHARYNGEAL NODES

These nodes are not present in the dog or the cat but are present in the primate. They vary in number from two to ten and are divided into a median and a lateral group. The former drain into the latter, and both groups tend to atrophy with age.[3] The median group atrophies first, frequently leaving only a single lateral node, which may atrophy on one side; total absence of these nodes is rare.[2b] The physiologic atrophy of the retropharyngeal nodes subjects the one in whom it occurs to greater physiologic difficulties during lymphatic blockage resulting from infection. During the time partial atrophy has occurred in these nodes, the regions which they drain, i. e., the sinuses, the eustachian tube, the middle ear, the mastoid process and others, have reached their maximum development, and though one may not be as susceptible to infection as one was when younger, there is less drainage of lymph from these parts when infection does occur. This frequently results in swelling of the lymph nodes and lymphatic blockage with resulting lymphedema of the mucosa of the lymph bed.

The obscure location of these nodes in a region where they may not be readily visualized or palpated has been responsible for the lack of observations concerning their function when diseased. Their anatomic distribution has been credited with certain pathologic predispositions. The intimate relationship of the lateral retropharyngeal nodes to the superior pole of the superior cervical sympathetic ganglion has been credited with "causing sudden death during retropharyngeal abscess".[2b] A swollen subtubal node which lies between the levator and tensor veli palatini muscles [4] has been credited with closing of the eusta-

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Presented as a candidate's thesis and read by title to the American Laryngological, Rhinological and Otological Society, New York, June 9, 1944.

1. Arey, L. B.: Developmental Anatomy, ed. 4, Philadelphia, W. B. Saunders Company, 1940, pp. 465, 467 and 501.

2. (*a*) Larsell, O., and Fenton, R. A.: Lymphatic Pathways from the Nose, Arch. Otolaryng. **24**:696-713 (Dec.) 1936. (*b*) Rouviere, H.: Anatomy of the Human Lymphatic System, translated by M. J. Tobias, Ann Arbor, Mich., Edwards Brothers, Inc., 1938.

3. Burnam, C. F.: Irradiation Treatment of Hyperplastic Lymphoid Tissue, Laryngoscope **50**:671-675 (July) 1940.

4. Hartz, H. J.: The Lymphatics of the Nose and Nasopharynx, with Consideration of the General Lymphatic System, Tr. Am. Acad. Ophth. **16**:119-139, 1911. Rouviere.[2b]

chian tube by pressure or by tilting its axis.[5] The location of these nodes immediately lateral to the pharyngeal aponeurosis allows radium therapy to be administered to them efficiently by application of radium to the nasopharynx. It is conceivable that some of the beneficial effects of radium therapy as applied to the nasopharynx are due to the action of the rays on the retropharyngeal nodes as well as to their action on the hypertrophied nasopharyngeal or tubal lymphoid tissue.[6]

The lymph vessels from the sinuses, the middle ear and related structures are collected into the pretubal lymphatic plexus, through which free anastomoses occur. Vessels leaving this plexus pierce the pharyngeal aponeurosis and enter the lateral nodes. During lymphatic blockage of these nodes, lymph from an infected or a cancerous area may, by retrograde flow through this plexus, enter a previously normal area[7]; or this retrograde flow may pass through the connecting lymph vessels across the posterior end of the nasal septum and the soft palate to the plexus of the opposite side.[2b]

This anatomic arrangement of these lymph pathways is important in the etiology of catarrhal otitis media. Infection in the adenoid or the sinuses may produce lymphatic blockage of the retropharyngeal nodes with subsequent retrograde flow of lymph, leading to lymphedema of the lymph bed. Lymphedema of the mucosa of the eustachian tube produces stenosis at its isthmus.[5] This results in catarrhal otitis media and mastoiditis with effusion.[8] The latter condition if untreated frequently terminates, after organization of the fluid, in chronic catarrhal otitis media with its accompanying adhesions in the middle ear and deafness. The decussation of the lymph pathways between the pretubal plexuses accounts for the frequent finding of tympanic effusion on one side and the causal sinusitis on the opposite side.

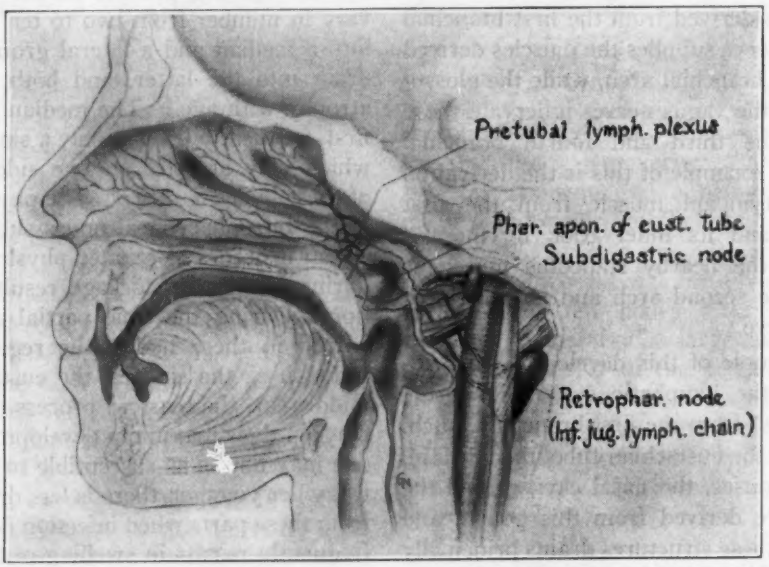

Fig. 1.—The lymph vessels from the mucosa of the tympanum, eustachian tube, adenoid, nasopharynx, sinuses and nasal cavities anastomose in the pretubal lymphatic plexus; then they pierce the pharyngeal aponeurosis and enter the lateral retropharyngeal and subdigastric lymph nodes.

(This drawing was copied from Rouviere[2b] and is used here by courtesy of the translator, M. J. Tobias.)

The physiologic atrophy of the retropharyngeal nodes evidently contributes to the tendency toward lymphatic blockage. The location of the catarrhal otitis media with effusion on the right or on the left in aged and middle-aged persons may be governed by the side on which atrophy has occurred. This suggestion is instigated by the great frequency with which one finds this effusion as a unilateral abnormality and the observation that the lateral nodes tend to atrophy

5. Robison, J. M.: Subacute Catarrhal Otitis Media and Mastoiditis with Effusion, South. M. J. **35**:815-825 (Sept.) 1942.

6. Crowe, S. J.: The Recognition, Treatment and Prevention of Hearing Impairment in Children, Laryngoscope **50**:658-662 (July) 1940. Guild, S. R., and others: Impaired Hearing in School Children, ibid. **50**:731-746 (Aug.) 1940. Burnam.[3]

7. Thompson, W. D.; Ravdin, L. S., and Frank, I. L.: Effect of Hypoproteinemia on Wound Disruption, Arch. Surg. **36**:500-508 (March) 1938. Tobias, M. J.: Personal communication to the author.

8. Cody, C. C., Jr.: Acute Catarrhal Mastoiditis, Texas State J. Med. **37**:233-236 (July) 1941.

on one side but rarely on both sides.[2b] The importance of lymphatic blockage of these nodes as an etiologic factor in effusion into the middle ear is increased when one takes into consideration the frequency with which this effusion occurs as the first symptom of metastasis to the lymph

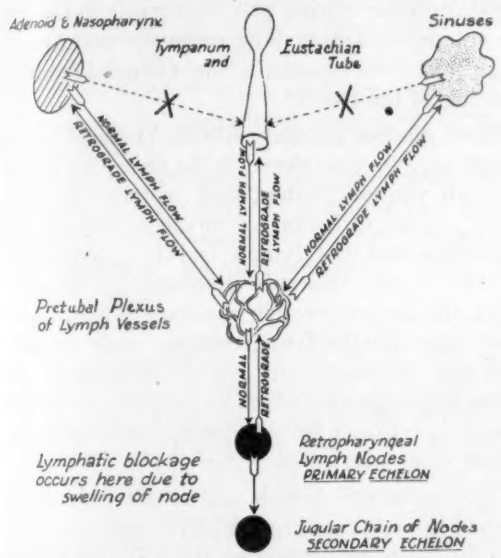

Fig. 2.—Normal and retrograde lymph flow. The lymph flow during lymphatic blockage due to a swollen node is illustrated. The normal lymph flow from the sinuses, the nasal septum, the adenoid, the nasopharynx, and eustachian tube and the tympanum is into the pretubal plexus and not directly from one of these areas into the lymphoid tissues of the eustachian tube. Infection in the sinuses or the adenoid imposed on a semiatrophic lymphatic system causes swelling of the nodes and blocking of the lymph flow. This results in retrograde flow through the freely anastomosing vessels of the plexus into the uninfected areas drained by the plexus. The lymphedema of the mucosa of the eustachian tube produced in this manner causes stenosis with resulting effusion into the tympanic cavity, which overflows into the cells of the mastoid process, from which it is not absorbed because the blood supply of the mucosa of these cells is sparse. Organization of this fluid leads to adhesive processes in the tympanum, terminating in chronic catarrhal otitis media with accompanying deafness.

nodes of a cancer of the nasopharynx. This usually occurs long before the tumor has become large enough to occlude the tubal orifice by direct pressure. In persons dying from cancer or tuberculosis there seems to be an increase in the number of lymph nodes; however, this has been shown to be due to hypertrophy of minute lymph nodes which exist along the normal lymph paths.[2b]

DISEASE OF THE LYMPHATIC BED

The lymphatic bed consists of the intercellular lymph spaces and pathways in the mucosa of the sinuses, nasal cavities, adenoid, eustachian tube, middle ear and mastoid process. For the purposes of this discussion, consideration will be given particularly to the characteristics of the lymph bed in the sinuses; for with the possible exception of the adenoid, the sinuses are the most frequent site of infection which affects the lymphatic system.

The mucosa of the normal sinus has a sparse blood supply and is practically devoid of lymph spaces, these being present only in sufficient number to nourish the ciliated epithelium and the normally loosely spaced cellular structure of the reticuloendothelial system.[9] Dyes and particulate matter are absorbed not at all, or with difficulty, by the normal mucosa. This is in contrast to the ready absorption of these substances by the lymph spaces, which open when traumatic, irritative or inflammatory edema occurs.[10]

To understand better the processes which occur in the mucosa of a sinus during bacterial invasion or allergic edema, it would be well to recount briefly some of the fundamental physiologic activities of the lymph bed in other parts of the

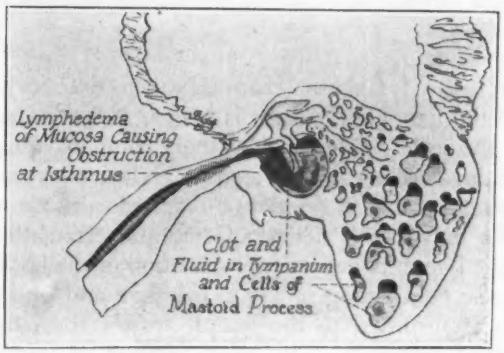

Fig. 3.—Lymphedema of the mucosa causing stenosis of the eustachian tube at its isthmus. Absorption of air from the cells of the mastoid and petrous portions of the temporal bone results in a sterile effusion filling the cells and the tympanum. Varying with the intensity of the stimulus to increased capillary permeability in the lymph bed of the sinuses, nasopharynx and related structures, the effusion may be a transudate of low protein content or it may be one of high protein content and form a clot containing its fibrin and mucoid and cellular elements. In pure form this condition occurs only in persons who have well pneumatized peritympanic bone.

9. Drinker, C. K., and Yoffey, J. M.: Lymphatics, Lymph and Lymphoid Tissue, Cambridge, Mass., Harvard University Press, 1941, pp. 4, 26, 53, 55, 58, 80, 83, 189-190, 284, 286, 289, 290, 291, 293, 300, 301, 305 and 307-309.

10. Childrey, J. H., and Essex, H. E.: Absorption from the Mucosa of the Frontal Sinus, Proc. Staff Meet., Mayo Clin. **6**:345-348 (June 10) 1931; Absorption from the Mucosa of the Frontal Sinus. Arch. Otolaryng. **14**:564-569 (Nov.) 1931.

body. The characteristics of the lymphatic system have been carefully studied by investigators clinically and experimentally, particularly in relation to elephantiasis and chronic infectional edema.[11]

The lymphatic system arises in the lower forms of life as an excretory system for the products of cell metabolism. In these creatures (sea urchin) the lymphatic channels open exteriorly, and the lymphatic system is bathed in sea water. As the scale of life becomes more complex, these openings become closed, and lymph hearts appear (fish, amphibians, reptiles).[9] In birds and mammals, valves and nodes appear, and circulation of the lymph is dependent on motion of the body, muscle contraction, gravity, massage and pulsation transmitted to the lymph vessels from the arterial system.[12] The latter method of lymph circulation occurs particularly during inflammation from dilatation of the arteriovenous anastomoses.

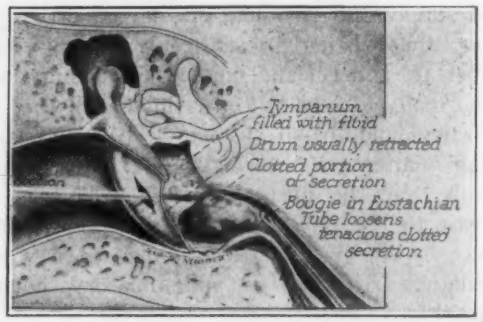
Tympanum filled with fibid
Drum usually retracted
Clotted portion of secretion
Bougie in Eustachian Tube loosens tenacious clotted secretion

Fig. 4.—Schematic drawing of fluid and clotted secretion in the tympanum and the method of removal. The clot is frequently so extensive and tenacious that it alone may be responsible for tubal stenosis. At times it so fills the orifice of the eustachian tube and the peritubal cells that it may come away in the form of a cast. Often it can be removed best by inflation and suction through an incision in the anterior quadrant of the drum.

The lymphatic system is as necessary to life as any other system. When lymph hearts are stopped, the organism dies; likewise, dogs die when complete lymphatic blockage is produced.[9] The essential functions of this system are the nourishing of the cells of the body by substances derived from the blood capillaries, the removing from the tissue fluid of products of cell metabolism, particulate matter and cellular detritus and the carrying away of excess protein in the lymph. The last function is one of its most important. In fact, one might consider the lymphatic system as a method of plasma autotransfusion, for during plasmapheresis in the dog the volume of lymph flow increases enormously in an effort to maintain the colloidal osmotic pressure of the blood.[9]

Blood plasma, capillary filtrate, tissue fluid and lymph may be considered to be the same except for their protein content and protein characteristics.[9] The diffusion of protein through the capillaries and the lymph bed is governed by the size of the molecule involved. Albumin is about the largest protein molecule which passes freely through the lymph spaces, while globulin does not diffuse at all.[9] If globulin does gain access to the lymph bed, as by injection or hemorrhage, it remains in situ for a protracted time before being carried away.[9]

The volume of lymph and tissue fluid in the normal body is equal to the blood volume. These two fluids are held apart by the colloidal osmotic pressure of the blood. This pressure in its greater part is derived from the protein content of the blood serum. This protetin content normally is always higher than the protein content of the lymph.[12] The transfer of fluid and its protein content from the blood to the intercellular lymph spaces and the absorption of this fluid are con-

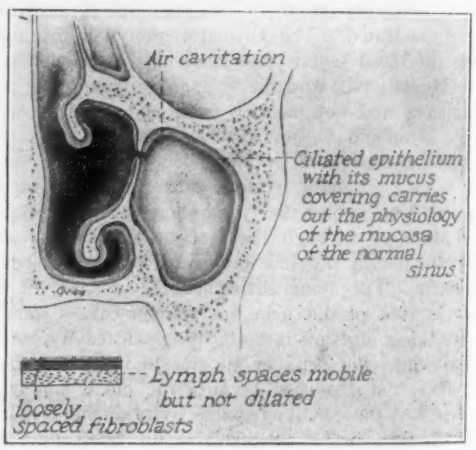
Air cavitation
Ciliated epithelium with its mucus covering carries out the physiology of the mucosa of the normal sinus
Lymph spaces mobile but not dilated
loosely spaced fibroblasts

Fig. 5.—Schematic drawing of the mucosa of the normal sinus. The function of the mucosa of the normal sinus consists principally in the cilia and their mucus covering keeping the cavity of the sinus free of extraneous material. The lymph spaces are "dry"; i. e., they contain a minimum of fluid of low protein content. These spaces are mobile in that they offer little tissue pressure resistance to increased capillary filtration during infection or irritation.

11. (*a*) Drinker, C. K.; Field, M. E.; Heim, J. W., and Leigh, O. C., Jr.: The Composition of Edema Fluid and Lymph in Edema and Elephantiasis Resulting from Lymphatic Obstruction, Am. J. Physiol. **109**:572-586 (Sept.) 1934. (*b*) Stevens, F. A.: Chronic Infectional Edema, J. A. M. A. **100**:1754-1758 (June 3) 1933.

12. Drinker, C. K.: The Lymphatic System: Its Part in Regulating Composition and Volume of Tissue Fluid, Lane Medical Lectures, Stanford University, Calif., Stanford University Press, 1942, vol. 4, no. 2, pp. 66-92.

trolled by the permeability of the blood capillaries.[13] The pressure in the arterial side of the capillary is normally higher than that in the venous side, resulting in partial absorption of the lymph by the venous side of the capillary. This absorption is normally limited, however, to water and salts, leaving the protein content, cellular detritus, particulate matter and products of cell metabolism to be carried away by the lymphatic system. During lymphatic blockage this absorption of water and salts leads to an increase in the concentration of protein in the edema fluid.

During inflammation there is increased permeability of the capillaries, resulting in a transudation into the tissues of a fluid rich in protein and leukocytic cellular elements. This fluid causes edema of the tissues, and tissue pressure is increased to a point which approaches the capillary pressure.[14] This increase in tissue pressure only reaches its maximum when the swelling has become extreme and produces an increase in the flow of highly proteinized lymph from the part. This flow is accelerated by arterial pulsation being transmitted to the lymph vessels by the dilated arteriovenous anastomoses working against the increased tissue pressure. The amount of protein brought to fibroblasts by the lymph controls their proliferation. As long as the lymph which bathes and nourishes the tissues contains a normal amount of protein, the fibroblasts remain dormant, but when there is an increase in the protein content of the lymph, an increase in the amount of fibrous tissue occurs in the part.[9]

During inflammation, as the permeability of the capillaries is increased fibrin is released into the lymph bed. The lymph channels are thereby blocked in an effort to localize the infection.[9] This leads to stagnation of the lymph and tissue fluid, with an increase in its content of protein and products of cell metabolism.[9] This lymphatic blockage is demonstrated by the facility with which dye and particulate matter are carried through the lymph channels when injected into normal tissue and their lack of transportation into an inflamed area when injected around its periphery. Also these substances when injected into the area of inflammation remain in situ.[9]

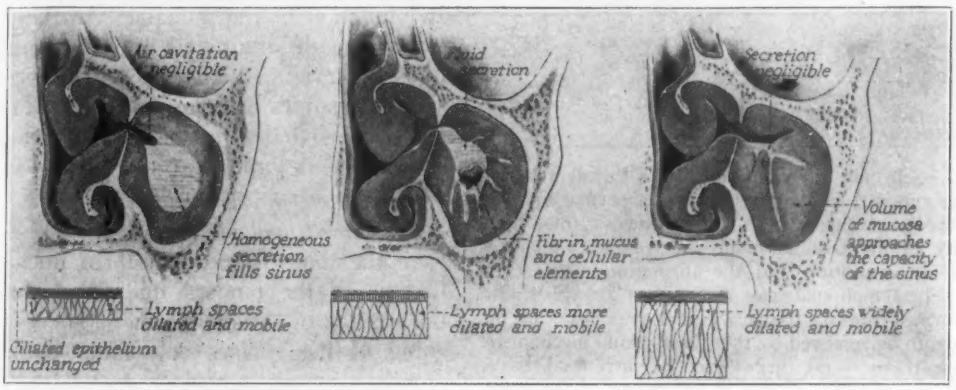
Air cavitation negligible
Homogeneous secretion fills sinus
Lymph spaces dilated and mobile
Ciliated epithelium unchanged
Fluid secretion
Fibrin, mucus and cellular elements
Lymph spaces more dilated and mobile
Secretion negligible
Volume of mucosa approaches the capacity of the sinus
Lymph spaces widely dilated and mobile

Fig. 6.—Stages of acute purulent sinusitis. The ability of the mucosa of the previously normal sinus to become edematous, to increase uniformly in volume and, with the aid of its secretion, to approximate the capacity of the sinus and then return to its normal thickness is a criterion of its physiologic efficiency. Lymphatic blockage, immunologic reactions, chemotherapy, mechanical treatment and other disturbances may arrest or hasten this cycle.

Because of the relative ease of observation, accessibility and frequency of involvement of the maxillary sinus, the application of the foregoing physiologic considerations to the lymph bed of the sinuses will be confined to this sinus and to some extent to the intranasal structures.

Following irritation by particulate matter or bacterial infection of the mucosa of the previously normal sinus, there is transudation of parts of the blood serum through the capillary walls into the lymph spaces of the reticuloendothelial system.[15] This results in an increase in volume of the mucosa, and since lymph spaces tend to open widely with swelling,[9] part of this fluid escapes into the lumen of the sinus as a secretion. The fibrin in this secretion forms, contracts and gathers into a mass the mucoid and cellular ele-

13. Krogh, A.: The Exchange of Water Between the Blood and the Tissue Spaces, in the Anatomy and Physiology of Capillaries, ed. 2, New Haven, Conn., Yale University Press, 1929.

14. Drinker, C. K.; Field, M. E., and White, J. C.: Lymph Pressures in Sterile Inflammation, J. Exper. Med. **56**:363-370 (Sept.) 1932.

15. Fenton, R. A.: "Reticulo-Endothelial" Components of Accessory Sinus Mucosa: Experimental and Clinical Observations, Arch. Otolaryng. **14**:586-595 (Nov.) 1931.

ments of the secretion, leaving in the surrounding area of the lumen the more fluid components of the secretion. The sequence of events which occur following this initial stage of reaction to infection will be considered as the classification of sinus disease now suggested is developed.

This classification is based on observations in a preliminary study of the physical structure of sections of mucous membrane taken from the six

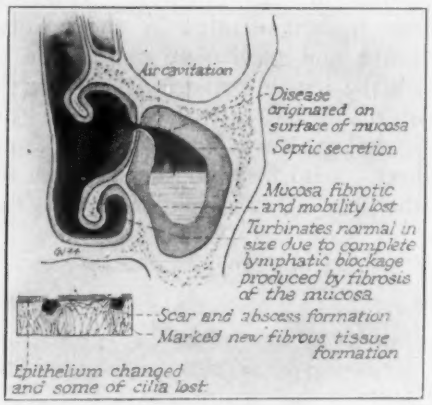
Air cavitation
Disease originated on surface of mucosa
Septic secretion
Mucosa fibrotic and mobility lost
Turbinates normal in size due to complete lymphatic blockage produced by fibrosis of the mucosa
Scar and abscess formation
Marked new fibrous tissue formation
Epithelium changed and some of cilia lost

Fig. 7.—Chronic purulent sinusitis. Purulent secretion long retained in the sinus leads to permanent uniform fibrosis of the mucosa. The mucosa then loses its ability to increase uniformly in volume, which results in air cavitation and the formation of a septic cavity. The lymph spaces of the mucosa are filled with newly formed fibrous tissue which leaves little in the lymph bed to be removed by the lymph pump mechanism. Therefore there is no turgescence of intranasal tissue to betray the presence of pus in the cavity of the sinus. This type of sinus tends to retain secretion following each infection.

walls of the maxillary sinus, the region of the ostium and the mucosa of the middle meatus. These specimens were procured during Caldwell-Luc operations and thus far have been examined microscopically only in relation to their physical characteristics. A more detailed report on their cellular characteristics will be the subject of a future communication.[16] For identification purposes, each wall of the maxillary sinus received a number, and each third of each wall received a letter in sequence in a clockwise direction in the left sinus and in a counterclockwise direction in the right sinus. The superior and the inferior wall were lettered in sequence from medial to lateral. These specimens were taken from a number of patients, due regard being given to their history of allergic manifestations, attacks of purulent sinusitis or both. Sections of mucosa from the various parts of the sinus were studied to determine, if possible, whether pathologic changes occur in the intercellular spaces and lymph vessels as they drain particulate material, cellular detritus, protein and other matter through the mucosa of the sinus, its ostium and the middle meatus. Also studied were the changes in the lymph bed resulting from fibrin's being deposited in the lymph vessels during lymphatic blockage accompanying purulent infection.

As a result of these observations a comparison of the physiology of the lymphatic bed as between allergy and purulent infection has been attempted, with certain implications regarding the pathologic physiology of the mucosa of the sinus. Since these sections were taken from patients in whom the normal function of the sinus had been completely destroyed, the mucosa presented the terminal stage of a pathologic process which began originally with slight changes in the structure and function of the mucosa. As these terminal stages are differentiated and compared, deductions concerning the earlier pathologic and physiologic changes will be made. These deductions will be based on the known physiology of the lymph bed in other parts of the body, part of which has been previously mentioned.

Chronic Purulent Sinusitis.—These sections gave the impression of uniform thickening and fibrosis of the mucosa due to an infection of the surface of the membrane. There was thickening of the surface epithelium, with scarring

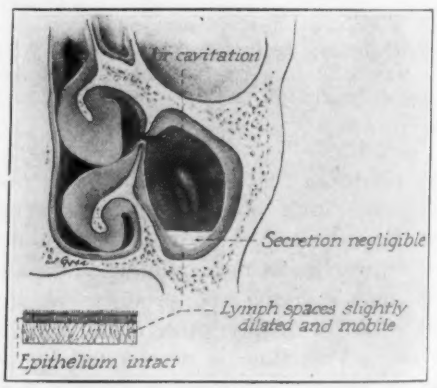

Fig. 8.—Acute allergic sinusitis. The turgescence of intranasal tissue caused by inhalation of pollen may so tax the lymph pump mechanism that the edematous process extends to the mucosa of the sinus and a small amount of secretion may form in the sinus, which may or may not become purulent. When this condition becomes static, great relief is afforded by irrigation of the sinus.

and abscess formation extending below the basement membrane. The fibrosis was found to be generalized without respect to the ostium. The mucosa of the middle meatus showed comparatively little change except cellular infiltration and fibrosis in certain instances.

16. Fenton, R. A., and Larsell, O.: An Experimental and Clinical Study of Histiocytes in Acute and Chronic Inflammation of the Accessory Sinuses, Laryngoscope **43**:233-241 (April) 1933.

Chronic Allergic Sinusitis.—These sections gave the impression that the thickening and fibrosis were due to pathologic changes which arose within the mucous membrane itself. The surface epithelium, though in some instances changed, was not destroyed as in the cases of purulent infection.[17] There were areas of widely dilated lymph spaces, particularly in the mucosa of the inferior wall of the sinus. The superior wall and the middle meatus showed dilated spaces, but these were more circumscribed and were surrounded by, and interspersed with, areas of increased density of fibrous tissue. Pedunculated polyps were prevalent in these upper areas, while sessile polyps were present on the inferior wall of the sinus. The mucosa of the vertical walls

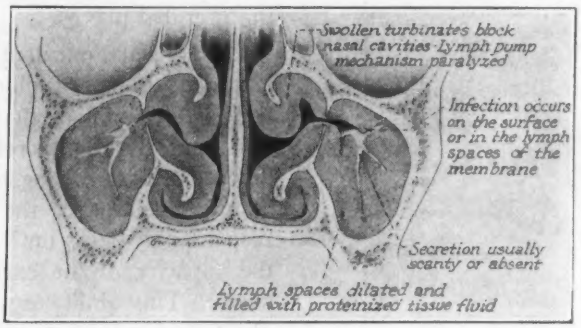
Swollen turbinates block nasal cavities Lymph pump mechanism paralyzed
Infection occurs on the surface or in the lymph spaces of the membrane
Secretion usually scanty or absent
Lymph spaces dilated and filled with proteinized tissue fluid

Fig. 9.—Acute lymphangitis of the mucosa of the maxillary sinus. This condition is usually due to infection gaining entrance to the dilated lymph spaces of a person suffering from nasal allergy. The mucosa swells until it approximates the capacity of the sinus. There may or may not be secretion in the sinus. Following traumatism of this mucosa, systemic complications such as pleurisy or pneumonitis are prone to occur. The edema of the mucosa and the turgescence of the intranasal tissue may remain for a protracted time, until alternating areas of fibrosis and dilated lymph spaces are formed in the mucosa of the sinus and the middle meatus. This condition after recurrent infection terminates in the chronic polypoid stage of the disease.

of these sinuses seemed to have a more uniform fibrosis than that of the horizontal walls.

Infection Superimposed on Allergic Sinusitis.—These sections gave the impression of a more actively progressive process. The dilated lymph spaces were more extensive and the fibrous tissue more dense. Abscess formation in the membrane was not a prominent finding, but the polyp formation appeared to be more extensive. The allergic characteristics of the membrane predominated, with involvement of the areas of the ostium and the middle meatus. Extension to the middle meatus of this process of interspersed areas of fibrosis and dilated lymph spaces was a prominent finding. Thus far, it has not been possible to distinguish between the structure of fibrous tissue in the mucosa resulting from infection and that resulting solely from an increase in protein in the tissue fluid.[9]

17. Freedman, A. O.: The Pathogenesis of Polyposis Nasi, Arch. Otolaryng. **2**:250-259 (Sept.) 1925.

COMMENT

Purulent Maxillary Sinusitis.—Air-containing cavities in the body tend to become filled with edematous tissue and secretion when called on to defend themselves against infection or severe irritation. This tendency is as prevalent in the sinuses as in the pulmonary alveoli, the middle ear and the mastoid process and has a sound physiologic reason.

During inflammation the edema fluid from the capillaries contains a relatively large amount of protein. Accumulated in this fluid also are the products of cell metabolism and cell destruction. All of these substances must be taken away from the area of inflammation by the lymph channels, since only the water, salts and some toxic products can be absorbed by the venous capillaries.[9] The sinuses, being enclosed in rigid walls,[18] are deprived of muscular motion to promote lymph flow and have to depend entirely on gravity and the pulsation of the arterial system to force the lymph through the lymph channels in the mucosa. This pulsation is enhanced by the arteriovenous anastomoses, which when open allow more blood to be pumped through the part than could be carried solely through the capillary bed. This pulsation is best carried to the lymph vessels by hydrostatic pressure. This pressure can be exerted in a cavity best when the cavity is filled with fluid or edematous membrane.

The application of pressure to a potentially edematous part as a means of increasing lymph

18. Proetz, A. W.: The Displacement Method of Sinus Diagnosis and Treatment, St. Louis, Annals Publishing Company, 1931, p. 29; Essays on the Applied Physiology of the Nose, ibid., 1941, p. 111.

flow and preventing stagnation of tissue fluid is a well recognized clinical procedure. For example, the immediate application of a cast to a broken limb not only splints the part but prevents the marked edema and stagnation of tissue fluid which would otherwise follow. Likewise, the application of a pressure bandage to the orbit following enucleation prevents marked swelling of the lids. If these measures are not used, the stagnation of tissue fluid renders the area more susceptible to infection, healing is delayed, and there is an increase of fibrous tissue in the part resulting in increased scar formation.[12]

The importance of the mucosa of the nose and sinuses being enclosed within rigid walls, against which it may swell and with the help

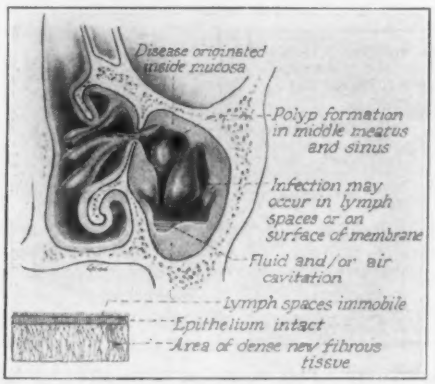
Disease originated inside mucosa
Polyp formation in middle meatus and sinus
Infection may occur in lymph spaces or on surface of membrane
Fluid and/or air cavitation
Lymph spaces immobile
Epithelium intact
Area of dense new fibrous tissue

Fig. 10.—Chronic lymphangitis of the mucosa of the maxillary sinus (chronic allergic sinusitis) and of the middle meatus. This condition is the result of long-continued retention of edema fluid in the interstitial spaces of the mucosa. When infection occurs following the formation of alternating areas of fibrosis and dilated lymph spaces in the mucosa, the rise in tissue pressure produces polypoid formations from the areas of dilated lymph spaces.

of arterial pulsation promote the flow of lymph from its bed, is demonstrated clinically by the complete obliteration of the nasal passage by swelling of the turbinates whenever there is a demand on the lymphatic system for removal from the lymph bed of products of inflammation or irritation. When this demand is moderate, the nasal passages are closed intermittently, forcing the lymph out; when the demand is great, the nasal cavity closes completely and remains so until the source of the increased protein and other matter in the lymph bed has been eliminated. This clinical sequence of events, i. e., closing of the nasal cavity when there is pathologic change in the lymph bed and prompt opening of the cavity when the pathologic condition of the lymph bed has been eliminated, suggests that this turgescence of intranasal tissue is a lymph pump mechanism which facilitates the flow of lymph. Added significance is given this conception by the gravity drainage of the lymph bed. If the patient is placed on his side during bilateral acute inflammation of the lymph bed of the nose and sinuses, the lymph bed which is uppermost drains by gravity and the upper nasal cavity is open, whereas on the lower side the nasal cavity closes to facilitate drainage of the lymph. During chronic purulent maxillary sinusitis, when localized complete lymphatic blockage due to fibrosis of the mucosa has occurred, there is no turgescence of intranasal tissue to betray the presence of pus in the maxillary sinus. The intranasal swelling is absent because there is little in the lymph bed to be removed by the lymph pump mechanism. Gravitation of lymph from one side of the nose to the other is possible through the communications across the soft palate between the pretubal plexuses.

During acute purulent maxillary sinusitis there is transudation of capillary filtrate into the mucosa with obliteration of the air-containing cavity of the sinus by the secretion and the edematous mucosa. The volume of the mucosa increases, and the volume of the secretion becomes correspondingly less, until the mucosa approaches the capacity of, or entirely fills, the maxillary sinus. This ability of the mucosa to fill completely, when necessary, the entire cavity of the sinus is one of its most important physiologic functions. The cilia with their mucus covering are charged with the important function of caring for the cavity of the normal maxillary sinus. During infection, however, the uniform increase in volume of the mucosa of the sinus is the important factor in the pathologic physiology.

When purulent secretion is allowed to remain in the sinus for a considerable time, the protein content of the tissue fluid of the mucosa becomes high. This inevitably results in proliferation of the fibroblasts, an increase in the cellular volume and a reduction in the lymph spaces of the reticuloendothelial system of the mucosa. The ability of the mucosa to increase uniformly in volume during, and to return to normal after, infection is then lost. This leads to air cavitation, chronic infection and the tendency to form a septic cavity. The length of time the mucosa is filled with edema fluid is one of the most important factors in determining whether or not the mucosa can return to normal following infection. Acute infection of the previously normal mucosa of the maxillary sinus is a constantly changing process. The protein content of the edema fluid and the volume of the mucosa are changing in relation to the volume of the secretion. The secretion is constantly changing in

its p_H, cellular, mucous and bacterial content.[19] When these changes are kept in their proper sequence, the mucosa can return to normal. However, if a static condition occurs, the mucosa becomes fibrotic and loses its mobility because of prolonged retention of protein in its tissue spaces.

Allergic Sinusitis.—(a) Acute Allergic Sinusitis: There is certain experimental and clinical evidence that the release of histamine is the source of the edematous reaction which occurs when pollen is brought in contact with the mucosa of an allergic person.[20] Many factors in this process are not known, but clinically patients suffering from acute hay fever may be divided into those having a lympnatic system which can carry away the excess protein, particulate matter and other matter in the edema fluid of the mucosa and those who have a lymphatic system which cannot.[9] In the former the nasal symptoms fluctuate with the periods of pollen inhalation; i. e., the patients have good and bad days, depending on the pollen content of the inhaled air. In the latter, lymphatic blockage occurs and results in continuous complete nasal stenosis and edema of the mucosa of the sinus. These patients frequently consult the rhinologist during, or some time after, the hay fever season, and though they are entirely free from bacterial infection, they usually respond quickly to irrigation of their maxillary sinuses with isotonic solution of sodium chloride. Following centrifugation of the washings from these patients, the sediment shows certain particulate material, the significance of which is not yet known.

(b) Chronic Allergic Sinusitis: Individuals suffering from this condition may be observed early in life to have intermittent or constant edema of their nasal mucosa with symptoms of allergic rhinitis. This edema after a period of time leads to proliferation of fibroblasts within the mucosa of the lymph bed. This fibrosis ultimately results in lymphatic blockage along the lymph channels of the mucosa of the sinus and the middle meatus with consequent formation of polyps. Since lymph channels tend to regenerate within four to eight days after obliteration,[9] this process of fibrosis and lymphatic blockage is necessarily a slow chronic, progressive process.[9]

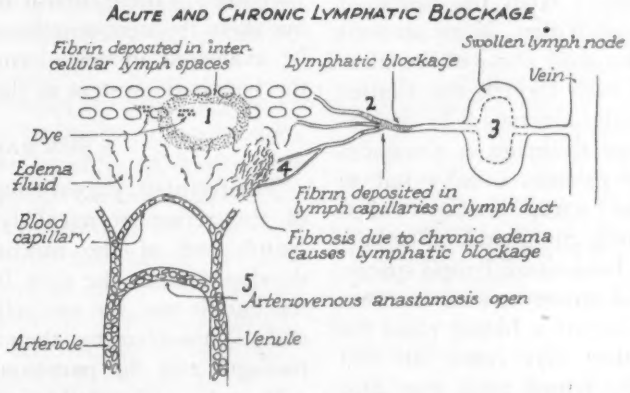

Fig. 11.—Diagrammatic drawing of types of lymphatic blockage occurring in the retropharyngeal lymphatic system: *1.* Fibrin is deposited in the intercellular lymph spaces as in abscess formation. Dye injected outside or inside the abscess fails to pass through the wall of fibrin. *2.* Deposition of fibrin in the lymph capillaries and ducts is followed by fibrosis as in the middle meatus. These lymph pathways tend to regenerate rapidly. *3.* When all of the lymph nodes draining an area swell and become blocked, lymphedema of the entire lymph bed occurs, as in certain types of catarrhal otitis media. 4. Chronic edema is followed by filling of the tissue spaces with newly formed fibroblasts. This fibrosis when complete, as it is in the mucosa of the patient with chronic purulent sinusitis, isolates the region from the surrounding lymphatic system. *5.* The arteriovenous anastomoses open during infection, exposure to cold and other disturbances. When open they allow more blood and heat to be brought to the part, reduce capillary filtration by lowering capillary pressure and promote the flow of lymph by transmission of their pulsations to the lymph vessels.

Infection Superimposed on Allergic Sinusitis.—The presence of edema fluid in the tissues renders them much more susceptible to infection.[9] This has been proved by the frequent occurrence of streptococcic infection in the leg of a dog after the leg has been subjected to experimental

19. Buhrmester, C. C.: A Study of the Hydrogen-Ion Concentration, Nitrogen Content and Viscosity of Nasal Secretions, Ann. Otol., Rhin. & Laryng. **42:** 1041-1058 (Dec.) 1933.

20. Katz, G., and Cohen, S.: Experimental Evidence for Histamine Release in Allergy, Chem. Abstr. **36:**555 (Jan. 20) 1942. Katz, G.: Histamine Release in the Allergic Skin Reaction, Proc. Soc. Exper. Biol. & Med. **49:**272-277 (Feb.) 1942.

elephantiasis. This occurs in spite of the natural immunity of the dog to streptococcic infection.[21]

These attacks of infection in the dog are similar to the attacks of infection seen in the edema fluid in elephantiasis in man and definitely accelerate the formation of fibrous tissue in the edematous part.[22] The swelling in elephantiasis is due at first to edema of the part, but later the enlargement is due to an overgrowth of fibrous tissues which obliterates the previously dilated tissue spaces.

In persons suffering from edema and polyposis of the mucosa of a sinus, infection may occur on the surface of the mucosa and also in the lymph spaces of the edematous membrane. When the lymph and tissue spaces become infected, the organism may be cultured from the inside of the edematous or polypoid tissue. Nasal stenosis is usually complete in the acute phase of the latter type of infection, and even though the sinuses are freely and frequently evacuated by irrigation and fistulous lymph drainage is promoted by polypectomy, these patients usually fail to recover their previous status readily unless treated with a sulfonamide compound. Furthermore, the fluid in these blocked-off lymph spaces, being low in bactericidal power and an excellent culture medium, may become a hiding place for bacteria from which they may come out and start an infection. The lymph node may also become a source of danger because of its tendency to hold viruses and later release them into the circulation.[9] Chronic infectional edema of the face and of the mucosa of the sinuses has been reported as possibly due to the draining of the products of bacterial infection from the portal of entry through the lymphatic system. The therapeutic value of bacterial filtrates in chronic infectional edema has been studied.[11b]

The sequence of allergic states through which many allergic persons pass is reflected in the gradual changes which occur in the lymph bed of the nose and sinuses. These patients often begin with hay fever, which sooner or later may result in chronic edema of the mucosa. This chronic edema produces an increase in fibrous tissue, which with or without added infection results in blockage of the lymph pathways with a terminal polypoid and edematous mucosa. Because of the lack of ready absorption of lymph from the area the symptoms of hay fever disappear. When the edema and polyposis attain a degree of swelling which causes sufficient increase in tissue pressure, the arterial pulsations begin to force the protein, the products of cell metabolism and the infective organisms through the cervical lymphatic duct to the venous system and the right side of the heart, from which they are carried to the pulmonary alveoli.[23] Then asthma may develop which may persist until the condition in the sinuses is corrected by an operation which removes the source of the products from the lymph bed of the nose and sinuses. When this has been accomplished, a new lymph bed is formed in this area, from which the lymph drainage is again good, and the patient may have hay fever again.[9] There are numerous variations of these clinical and pathologic changes, but their frequent simultaneous occurrence must be evaluated in considering the importance of the lymphatic system in the allergic states.

21. Drinker, C. K.; Field, M. E.; Ward, H. K., and Lyons, C.: Increased Susceptibility to Local Infection Following Blockage of Lymph Drainage, Am. J. Physiol. **112**:74-81 (May) 1935.

22. Drinker, C. K.; Field, M. E., and Homans, J.: The Experimental Production of Edema and Elephantiasis as a Result of Lymphatic Obstruction, Am. J. Physiol. **108**:509-520 (June) 1934.

23. Mullin, W. V.: The Relation of Paranasal Sinus Infection to Disease of the Lower Respiratory Tract, J. A. M. A. **87**:739-741 (Sept. 4) 1926.

SUMMARY

The retropharyngeal lymphatic system consists of the retropharyngeal lymph nodes and the lymph bed of the mucosa of the structures developed from the first branchial pouch, i. e., the middle ear, the eustachian tube, the adenoid and the nasopharynx, the nasal septum, the nasal passages and the paranasal sinuses.

Lymphangitis of this system frequently produces catarrhal otitis media and mastoiditis with effusion, which may terminate in the adhesive stage of chronic catarrhal otitis media.

The lymph bed of the mucosa of the sinuses is negligible until its spaces are opened by irritation or inflammation. Edema of the mucosa of the sinuses consists in dilatation of the lymph and tissue spaces with a capillary filtrate of increased protein content.

An increase in the protein content of the tissue fluid in the lymph spaces of the reticuloendothelial system of the mucosa leads to proliferation of the fibroblasts.

The percentage of the protein content of edema fluid and the length of time the fluid remains in the lymph spaces of the mucosa determine the amount of fibrosis which occurs in the mucous membrane.

The ciliated epithelium with its mucus covering carries out the physiology of the normal sinus. Fibrosis of the mucosa of the sinuses prevents the mucosa's uniform increase in volume in its effort to obliterate partially or completely the air cavity of the sinus, which is one of its

most important functions during infection or irritation.

Disease of the mucosa of the maxillary sinus may be classified as: A. Disease arising within the cavity of the sinus, such as purulent infection, which particularly affects the surface of the mucosa. This produces uniform fibrosis which may terminate in complete lymphatic blockage of the mucosa of the sinus. B. Disease arising within the mucosa itself as in allergic sinusitis. This produces alternating areas of fibrosis and dilatation of the lymph spaces of the mucosa. This process may extend to the middle meatus. C. Infection superimposed on allergic sinusitis. In this type the process of fibrosis within the mucosa is accelerated. As the tissue pressure rises polyps are formed from the areas of dilated lymph spaces.

Lymph is drained from the nose and the sinuses by gravity and arterial pulsation transmitted to the lymph vessels. The lymph pump mechanism which functions particularly during inflammation of the lymph bed depends for its efficiency on partial or complete obliteration of the air-containing cavities of the nose and the sinuses, to facilitate the transmission of arterial pulsation to the lymph vessels by hydrostatic pressure.

The simultaneous occurrence of changes in the lymph bed of the sinuses and the clinical manifestations of allergy must be taken into consideration in evaluating the importance of the lymphatic system in the allergic states.

During the first six weeks of acute purulent otitis media and mastoiditis proper treatment will usually prevent the chronic stage of the disease. How long can sinusitis with edema of the mucosa continue and have the mucosa return to normal after the cause of the disease has passed? Aid in answering this question is anticipated by further study of the physical and chemical characteristics of the edema fluid and its effect on fibroblasts as observed during tissue culture.

A great amount of aid and cooperation in this study was given by the following associates in the University of Texas School of Medicine: Dr. John G. Sinclair, professor of histology and embryology; Dr. Paul Brindley, professor of pathology; Dr. George Dechard, associate professor of medicine; Dr. Ludwig Anigstein, assistant professor of preventive medicine and public health, and their assistants. Mr. Peter S. Erhardt and Miss Dorothea Neubauer gave assistance in chemistry and bacteriology. Mr. R. A. Sage and Mr. George A. Newman, of the department of medical illustrations, gave technical aid. The works of Dr. Cecil K. Drinker, professor of physiology at Harvard University, have been quoted freely.

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MALIGNANT TUMORS OF THE NASAL CAVITY

REPORT OF EIGHT CASES IN WHICH A FRONTOETHMOID APPROACH WAS EMPLOYED

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Many methods of approach to the nasal cavity and paranasal sinuses have been devised for the removal of benign and malignant tumors and for the treatment of suppurative disease of the paranasal sinuses. We shall consider briefly the literature regarding these methods and the method of approach which we have used with satisfaction in certain selected cases in which malignant growth has been found in the nasal cavity but in which there has been little or no roentgenographic evidence of involvement of bone.

In 1893 Jansen,[1] considering the treatment of chronic suppuration of the paranasal sinuses, described an incision which curves along the eyebrow around the inner angle of the eye from the supraorbital notch and which permits access to the sinuses. Lynch[2] (1924 and 1929), Sewall[3] (1926 and 1935) and Luongo[4] (1936) gave excellent descriptions of a similar approach which they employed in the treatment of inflammatory conditions. The frontoethmoid approach which we have used is almost identical with that described by these writers.[5]

The literature contains reports of many cases in which Moure's[6] operation, or lateral rhinotomy, has been performed. In using this procedure, two incisions are made on the affected side, each beginning below the inner extremity of the eyebrow and midway between the inner canthus of the eye and the root of the nose. The first incision curves outward along the infraorbital ridge to the prominence of the malar bone. The second incision extends downward along the side of the nose, around the ala and into the nasal vestibule. The incisions are extended down to bone, and the periosteum and soft parts are elevated so that the nasal and maxillary bones and the infraorbital ridge can be defined. With gouge and hammer, the nasal bone is divided from the opposite nasal bone just lateral to its junction with the nasal septum. The nasal bone and the ascending process of the maxillary bone are separated from the frontal bone by following the suture line. The maxillary bone is divided on a line extending from the lower lateral angle of the piriform opening to the inner extremity of the lower border of the orbit, care being taken to avoid injury to the infraorbital nerve. The triangular bony section thus isolated is removed. This procedure allows exposure of the nasal cavity, the ethmoid region and the upper part of the maxillary region.

In 1907 Williams[7] described the following approach: The first incision extended down the lateral portion of the nose to the inferior border of the nasal bone. The second incision, which started at a point internal to the inner canthus, extended along the infraorbital margin to its middle point. These two incisions were united above by a transverse incision. An osteoplastic flap then was fashioned. This permitted access to the nasal cavity.

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From the Section on Laryngology, Oral and Plastic Surgery (Dr. Havens) and the Section on Otolaryngology and Rhinology (Dr. Thornell), Mayo Clinic.

1. Jansen, A., cited by Lillie, H. I., and Williams, H. L.: The External Fronto-Ethmo-Sphenoid Operation: A Critical Review of the Literature and Details of the Technic in Use at the Mayo Clinic, Minnesota Med. **18**:786-789 (Dec.) 1935.

2. Lynch, R. C.: The Technique of a Pan-Sinus Operation Which Has Given Me the Best Results, Tr. Am. Laryng., Rhin. & Otol. Soc. **30**:205-211, 1924; Symposium on Ethmoidal Sinusitis: External Radical Approach, Ann. Otol., Rhin. & Laryng. **38**:931-939 (Dec.) 1929.

3. Sewall, E. C.: External Operation on the Ethmosphenoidfrontal Group of Sinuses Under Local Anesthesia, Arch. Otolaryng. **4**:377-411 (Nov.) 1926; The Operative Treatment of Nasal Sinus Disease, Ann. Otol., Rhin. & Laryng. **44**:307-316 (June) 1935.

4. Luongo, R.: External Frontoethmosphenoidal Operation, Laryngoscope **46**:1-25 (Jan.) 1936.

5. After our paper had been written, we discovered that B. E. Ellis had employed a similar approach in a case of nasal tumor (An Unusual Nasal Tumor, Arch. Otolaryng. **38**:65-68 [July] 1943).

6. Moure, E. J., cited by Thomson, S. C.: Malignant Disease of the Nose or Accessory Sinuses, Lancet **1**:987-992 (May 13) 1916.

7. Williams, P. W.: A Case of Malignant Growth of the Septum and Naso-Pharynx Removed by an External Osteoplastic Operation, Proc. Roy. Soc. Med. (Sect. Laryng.) **1**:115-117, 1908.

Schall [8] (1939) advised the use of a modified Moure incision starting medial to the inner canthus of the eye and extending along the nasofacial groove and around the ala to the middle of the upper lip. The columella nasi is separated from the upper lip and the incision then is extended through the buccal mucous membrane and follows the upper alveolobuccal fold "from the nasal spine to the last molar tooth." The superior maxilla then can be exposed by retracting the cheek. The maxillary sinus can be opened, and a tumor can be exposed and treated as conditions may require.

Barnes [9] in 1920 and again in 1927 considered the treatment of malignant tumors of the paranasal sinuses by means of an open operation immediately followed by irradiation. He used an almost circular incision that started at the lateral portion of the eyebrow, followed the line of the brow, then extended downward medial to the inner canthus, then out across the cheek parallel to the lower rim of the orbit and ended in the malar region. An opening was then made into the ethmoid region and the maxillary sinus. The tumor was removed, and the cavity was packed with gauze. A radium tube was placed in the middle of the packing. The author originally intended to permit the opening to remain open for three years, so that he could observe any recurrence of the malignant lesion, but in some cases plastic closure was performed at the end of one year. Twenty-five cases were reported, and the results were satisfactory in 13 cases (52 per cent).

In Ollier's [10] operation the incision extends from the base of one ala nasi up along the base of the nose to the bridge, then across the bridge and down the other side of the nose to the opposite ala; the bony structures forming the bridge superiorly are severed along the line of the incision. The nose is then turned downward, allowing access to the nasal cavity.

In Rouge's [11] operation the sublabial approach is used. In this operation the incision is made across the upper gum, and the soft parts are separated from the bone, exposing the nasal cavities.

In Preysing's [12] operation one incision is made horizontally from just above the inner extremity of one eyebrow to a corresponding point over the opposite eyebrow. The second incision, which is perpendicular to the first, extends down the middle of the nose. In Kocher's [13] operation (used in resection of the superior maxilla) one incision starts in the malar region, curves under the lower eyelid to the side of the nose and then downward in the nasofacial groove, around the ala and divides the upper lip in the midline. The second incision extends from the angle of the mouth out onto the cheek.[14]

Carcinoma within the nasal cavity is most likely to be found on the septum or high on the lateral wall of the nasal passage. Recent nasal obstruction and increased nasal discharge or purulent discharge with bleeding should bring the possibility of malignant neoplasm to mind. We should like to emphasize that, although nasal obstruction often is attributed to polyps, recent nasal obstruction, particularly in a case in which the patient is more than 40 years of age, is not likely to be due to polyps. Far too frequently we have seen such patients who have had what were called polyps removed, sometimes repeatedly, without a suspicion of carcinoma having been entertained and without the removed tissue having been submitted to a pathologist. After such mismanagement, carcinoma has been found hopelessly advanced when the diagnosis was established.

Another point to be remembered is that if a mass in the nose bleeds readily on slight trauma or if its removal is followed by free bleeding, one should suspect a malignant lesion.

Nasal bleeding may be attributed to "high blood pressure" or to traumatic ulceration of the region of Kiesselbach's plexus. Suspicion is warranted, however, until it can be proved that some such cause rather than carcinoma does account for the bleeding.

A carcinomatous mass which may not be primary in the nose may be found in a nasal passage. It may be an extension into the nose from the maxillary sinus or from the cells of the ethmoid bone. Such a mass in the nose, whether or not it is primary, often is ulcerated and infected.

8. Schall, L. A.: Diagnosis and Treatment of Malignant Diseases of the Nose and Nasal Sinuses, J. M. Soc. New Jersey **36**:78-81 (Feb.) 1939.

9. Barnes, H. A.: The Combined Operative and Radium Treatment of Malignant Disease of the Nasal Accessory Sinuses, Boston M. & S. J. **183**:648-656 (Dec. 2) 1920; Malignant Tumors of the Nasal Sinuses: A Further Report of the Results of the Wide Open Operation Followed by Immediate Radiation, Arch. Otolaryng. **6**:123-138 (Aug.) 1927.

10. Ollier, cited by Ballenger, W. L.: Diseases of the Nose, Throat and Ear: Medical and Surgical, Philadelphia, Lea & Febiger, 1925, pp. 287-288.

11. Rouge, cited by Thomson, S. C.: Diseases of the Nose and Throat, ed. 3, New York, D. Appleton-Century Company, Inc., 1926, pp. 826-827.

12. Beck, J. C.: Malignant Diseases of the Nose and Nasal Accessory Sinuses, Tr. Am. Acad. Ophth. **36**:20-38, 1931; see fig. 8, p. 30.

13. Beck,[12] fig. 9, p. 30.

14. We are discussing only methods of external approach to the nasal cavity and have purposely omitted discussion of the transantral approach.

This probably is due to trauma from crusting and perhaps is aggravated by the patient's efforts to clear the nostril. This has an important bearing on the diagnosis because the instrument with which a specimen is obtained for biopsy may remove only inflamed seminecrotic portions of the tumor. It is difficult or impossible for a pathologist to make a correct diagnosis on examination of such tissue. A negative report, therefore, must not be accepted with complete assurance until it is certain that a representative specimen has been examined by the pathologist.

Roentgenograms of the paranasal sinuses are essential in cases of tumor. We have observed a number of cases in which the sinuses appeared cloudy on the side on which the lesion was situated and clear or comparatively clear on the opposite side. We believe this appearance is of diagnostic importance and that it suggests obstruction due to neoplasm rather than to an inflammatory process. Erosion of bone indicates extension of the malignant lesion beyond the nasal mucosa.

The final diagnosis rests on biopsy. A determination of the degree of malignancy by grading according to the method of Broders is of great aid in deciding on the best plan of treatment.

METHOD OF APPROACH

In the treatment of malignant growth within the nasal cavity when the roentgenogram reveals little or no evidence of involvement of bone, adequate exposure is important for several reasons: (1) to ascertain the extent of the tumor and to find its point of attachment, (2) to permit proper control of hemorrhage and (3) to permit removal of the tumor and, if necessary, accurate implantation of radium. In some of our cases it was found that the tumor, although large, was attached by a narrow pedicle. Without adequate exposure it would have been impossible either to ascertain this or to carry out the accurate removal which is essential to successful treatment.

The incision is started just under the unshaven eyebrow, 1 cm. lateral to its inner extremity. It is extended medially and then downward midway between the inner canthus of the eye and the middle of the dorsum of the nose, then down the nasofacial sulcus to end just below the free edge of the nasal bones. The incision is carried through the soft tissues and periosteum and down to the bone. The operative field is kept clear by the use of continuous suction throughout the operation, and bleeding points are ligated or coagulated with the electrosurgical unit. By using a sharp periosteum elevator, the periosteum is elevated from the bone medially as far as the middle of the nose and laterally as far as the lacrimal bone, care being exercised to avoid damage to the lacrimal sac. Elevation of the lacrimal sac from its fossa and of the periosteum from the lamina papyracea may be required if extension of the tumor into the cells of the ethmoid bone makes it necessary to explore the whole ethmoid region. An incision is made through the nasal mucous membrane along the lower free edge of the nasal bone, and the mucous membrane is freed from the under surface of this bone. Access to the nasal cavity is then gained by using a rongeur to remove portions of the nasal bone and of the nasal process of the maxillary and frontal bones, after which an incision is made through the nasal mucous membrane parallel to the incision of the skin, thus exposing the interior of the nasal cavity. The point of attachment and the extent of the tumor are then determined and the necessary procedures planned. If the attachment of the tumor is mainly in the ethmoid region, it becomes necessary to expose the ethmoid cells by removing the lacrimal bone and a portion of the lamina papyracea of the ethmoid bone. If the attachment is in the region of the maxillary osteum, it usually is advisable to open the maxillary sinus as is done in the Caldwell-Luc operation and to examine this sinus carefully for evidence of extension of the tumor. In some cases, examination of the frontal or the sphenoid sinuses may be necessary. After removal of the tumor, the point of attachment is thoroughly electrocoagulated, and radium is applied over the coagulated region. The radium is held in place with gauze packing so arranged that both radium and packing can be removed through the nostril. The wound is then closed with subcutaneous interrupted catgut sutures, and the edges of the skin are approximated with black silk. A pressure dressing is then applied. The sutures are removed in three or four days. After healing is complete the scar usually is quite inconspicuous.

REPORT OF CASES

CASE 1.—A 58 year old white woman came to the clinic on Aug. 27, 1934. Eight years previously she noted nasal obstruction on the left side, and shortly thereafter removal of "polyps" relieved the obstruction. Four and a half years later she again noted nasal obstruction on the left side, and removal of "polyps" again produced relief. The "polyps" were not examined microscopically on either occasion.

In the year before she came to the clinic she again noted nasal obstruction on the left side. She also had had a mucopurulent nasal discharge. For a short time before she came to the clinic she had pain over her left cheek.

At the clinic the left nasal cavity was seen to be filled with a mass having the appearance of polyps. Microscopic examination of tissue removed from the mass revealed squamous cell epithelioma, grade 1 (on the basis of 1 to 4). Roentgenologic examination of the nose and accessory sinuses revealed no evidence of destruction of bone.

The lesion was exposed by the frontoethmoid approach. The left ethmoid region was extensively involved, but there was no invasion of the bony structures. All the tumor was removed. The interior of the left maxillary sinus was not involved. Radium was applied to the region from which the growth had been removed.

Fig. 1 (case 3).—Cloudiness of the right frontal sinus and ethmoid region caused by carcinoma. There is no evidence of destruction of bone.

The patient has reported for observation at intervals, and when she was last seen, eight and a half years after the operation, the tumor had not recurred.

It is our belief that the result in case 1 was due to the surgical removal rather than to the effect of the radium and that no other type of exposure would have served as satisfactorily as did the frontoethmoid approach.

CASE 2.—A white man aged 46 years came to the clinic on Jan. 28, 1934. During the preceding year he had noted intermittent nasal obstruction of the right side. The nasal obstruction had been complete and continuous for two months. Biopsy disclosed a malignant tumor. Inspection showed a mass which filled the right nasal cavity and bulged into the nasopharynx through the choana. Roentgenologic examination revealed a soft tissue tumor but no evidence of involvement of bone.

Exploratory operation demonstrated that the tumor involved only the right ethmoid bone. The pathologist classified the lesion as squamous cell epithelioma, grade 1. Complete exenteration of the ethmoid air cells on the right side was carried out. The right frontal sinus, the right sphenoid sinus and the right maxillary sinus were opened, but there was no evidence that they were involved. Three years and eight months after the operation the patient remained free of recurrence.

CASE 3.—A white woman aged 49 years came to the clinic Dec. 20, 1939. For two years she had had occasional attacks of bleeding from the right side of the nose. Obstruction of the right side of the nose had been present for two months, and she recently had one attack of severe epistaxis. Two weeks before she came to the clinic biopsy disclosed a malignant lesion. Inspection revealed a mass which filled the right nostril, and posterior rhinoscopy showed that it was protruding from the choana. Roentgenologic examination demonstrated a soft tissue tumor and cloudiness of the right ethmoid region but no evidence of erosion of bone (fig. 1).

Exploratory operation revealed that the tumor involved only the anterior air cells of the ethmoid bone. The pathologist classified the lesion as carcinoma, grade 4, probably adenocarcinoma. Exenteration of the right ethmoid air cells was carried out, and radium was applied to the point of origin of the tumor. Four years after the operation there was no evidence of recurrence.

CASE 4.—A 73 year old white man came to the clinic Feb. 27, 1941. Obstruction of the right side of the nose had been noted for two years. Three weeks previously he noted bulging of the right side of the nose, and three days before his arrival biopsy disclosed a malignant lesion.

Fig. 2 (case 4).—Tumor removed from the nasal cavity, showing the small pedicle by which it was attached high in the right ethmoid region. The ball-like portion of the tumor hung in the nasopharynx and the rest of the tumor filled the nasal cavity.

There was a mass presenting in the right nasal vestibule. It filled the nasal cavity and caused bulging of the right side of the nose. Posterior rhinoscopy revealed a large mass which completely filled the right choana and protruded into the nasopharynx. Roent-

genologic examination disclosed questionable erosion of the bone separating the nasal cavity from the maxillary sinus on the right side.

Exploratory operation revealed that the tumor was attached high in the right ethmoid region and only by a small pedicle (fig. 2). By the simple expedient of introducing a finger through the mouth into the nasopharynx, the mass filling the choana was pushed forward and the entire tumor delivered through the operative wound. On account of the site of attachment of the tumor, electrocoagulation was considered inadvisable. Radium was applied directly to the base of the pedicle. The pathologist reported that the tumor was hemangioendothelioma, grade 4. When the patient was examined three months after the operation, there was no evidence of recurrence.

In case 4 it was only because of adequate exposure that it was possible to determine that the tumor arose from a small pedicle. Removal then was simple. The accurate placing of the radium was of great importance, owing to the highly malignant nature of the tumor.

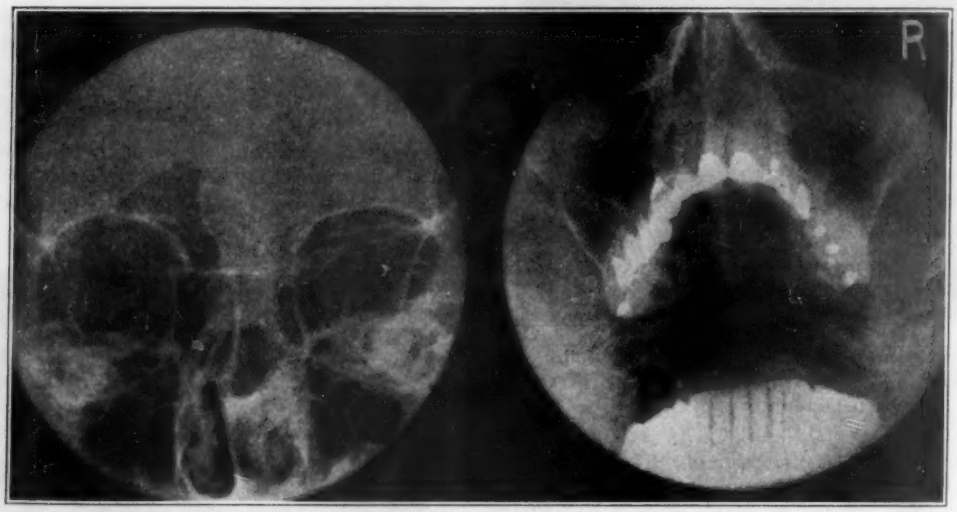


Fig. 3 (case 5).—Cloudiness of the frontal sinus and ethmoid region caused by carcinoma. There is no evidence of destruction of bone.

CASE 5.—A 38 year old white woman registered at the clinic on April 1, 1941. Ten months previously, because of arthritis, "polyps" were removed from the right nostril, and at the same time tonsillectomy and adenoidectomy were performed. Two months later, attacks of severe right-sided nasal hemorrhage began. These continued at irregular intervals. One month before she came to the clinic, biopsy of a mass in the right nasal cavity revealed "carcinoma." A mass was visible high in the right nasal cavity, and on posterior rhinoscopy the same mass could be seen in the choana. Roentgenologic examination revealed cloudiness of the right frontal sinus and the ethmoid region (fig. 3), but there was no evidence of destruction of bone.

Exploratory operation disclosed that the tumor was attached at two sites: (1) a region high on the nasal septum, 1.5 cm. in diameter, and (2) a smaller region on the lateral wall of the nasal cavity. There was no evidence of involvement of bone. The tumor was removed, the points of attachment were electrocoagulated thoroughly and radium was inserted. The pathologist reported that the tumor was adenocarcinoma, grade 4, which simulated sarcoma.

Four months after the operation, a small recurrent tumor was observed on the nasal septum. Radium was inserted in the tumor. When the patient was examined a year and three months later, there was no evidence of recurrence.

In case 5 the frontoethmoid approach permitted accurate placing of radium in contact with the points of origin of the tumor.

CASE 6.—A white woman 60 years of age came to the clinic on April 11, 1941 because of nasal obstruction. Three years previously a "polyp" was removed from her right nostril. A pathologist reported that it was benign.

Six months later, nasal obstruction was noted again. The severity of obstruction increased. Two weeks before the patient came to the clinic, biopsy disclosed that the obstructing tumor was benign but that it was not composed of typical polypoid tissue.

Inspection revealed a tumor that filled the posterior portion of the right nasal passage. Roentgenologic examination did not present any evidence of involvement of bone. Exploratory operation, which was performed by means of the frontoethmoid approach, revealed a tumor which arose from a small attachment in the region of the maxillary ostium and filled the nasal cavity. Microscopic examination disclosed that the tumor was adenocarcinoma, grade 1. The tumor was removed and the point of attachment electrocoagulated. As the tumor was situated at the maxillary ostium, the interior of the maxillary sinus was inspected. This was done by using the Caldwell-Luc procedure. A nodule of tumor was found inside the ostium. This was electrocoagulated. Three years later the patient was free of any evidence of recurrence.

We feel that the frontoethmoid approach was particularly valuable in case 6 because by its use we were able to determine accurately the point of origin of the tumor.

CASE 7.—A white man 71 years of age registered at the clinic on May 12, 1941. For one year he had noted nasal obstruction on the right side and pain over the forehead. Seven months previously he blew a piece of "flesh" from his right nostril, and this was followed by temporary relief.

Two and a half months before he came to the clinic he had the first of several severe hemorrhages from the right nostril. Shortly thereafter a biopsy disclosed an active malignant tumor. Roentgen therapy resulted in cessation of the nasal hemorrhages. A hemorrhagic-appearing mass filled the right nostril and was visible on posterior rhinoscopy. Roentgenologic examination did not reveal any evidence of involvement of bony structures. Exploratory operation disclosed that the tumor arose from a small region just above the middle turbinate on the right side. The tumor was removed, the point of origin electrocoagulated and radium applied. The tumor was classified as a hemangioendothelioma, grade 2.

The patient returned to the Philippine Islands after an uneventful recovery. We have no further information as to his condition.

CASE 8.—A white man aged 50 came to the clinic on Aug. 29, 1941. He had had a discharge from the right side of the nose for one month and obstruction of this side of the nose for two weeks. One week before he came to the clinic, biopsy revealed carcinoma. Examination disclosed a mass which filled the right nasal cavity and was visible on posterior rhinoscopy. Roentgenologic examination did not reveal any evidence of involvement of bone. Exploratory operation uncovered a tumor which arose from the lateral wall of the right nasal cavity between the middle and inferior turbinates and extended posteriorly. The tumor was removed and the site of attachment electrocoagulated. The maxillary sinus was opened by the Caldwell-Luc operation and its interior inspected. A small amount of tumor was found at the ostium and was electrocoagulated. Radium was applied to the site of origin. The tumor was classified as carcinoma, grade 4, probably adenocarcinoma. Two years later there was no evidence of recurrence.

COMMENT

Our experience has convinced us that the operation described is valuable in cases of malignant tumor of the nasal cavity in which there is no roentgenographic evidence of involvement of bone.[15]

102 Second Avenue (Dr. Havens).

15. Since this paper was written we have performed operations in 8 additional cases with entirely satisfactory results except in 1 case in which the patient had an extensive, actively malignant tumor that recurred promptly and is progressing in spite of intensive irradiation.

USE OF RADON TO PREVENT OTITIS MEDIA DUE TO HYPERPLASIA OF LYMPHOID TISSUE AND BAROTRAUMA (AERO-OTITIS)

MAJOR EDMUND P. FOWLER JR.

MEDICAL CORPS, ARMY OF THE UNITED STATES

Examination of American soldiers in England reveals that they are even more prone to have hyperplasia of pharyngeal lymphoid tissue, secondary eustachian salpingitis and consequent otitis media on this island than in the United States. Whether this is due to climate or to living conditions or to something else is difficult to say. A high percentage of flying personnel come to hospitals with a history of recurrent acute catarrhal otitis media. In the ear, nose and throat section of one general hospital 0.8 per cent of ground personnel and 22 per cent of flying personnel had a history of recent otitis when examined. Nearly all of them had sufficient excess lymphoid tissue around their eustachian tubes to account for this.

Since the publication of the article by Crowe and Baylor [1] on the prevention of deafness in childhood by using radon in the nasopharynx, the work at the Johns Hopkins University has been repeated in New York [2] as well as in several other cities.[3] It seemed reasonable to try radiation in the treatment of soldiers since their otitis occurred with excess lymphoid tissue which resembled that seen in children with the same condition. The use of radon appeared particularly applicable to airmen, because interference with normal function of the eustachian tube by even a small amount of swollen tissue is likely to cause trouble when they change altitude.

Through the auspices of Prof. Alfred E. Barclay, of Oxford, England, contact was made with Prof. Sidney Russ, of the Middlesex Hospital, London, who arranged for the delivery of radon at regular intervals, from the Central Radon Institute, Barton-in-the-Clay, Bedfordshire. Treatments were begun in December 1942, and up to March 1944, 220 patients had been treated. The most convenient dose for the laboratory to ship and to put into the capsules provided was 75 millicuries per capsule. The capsules are made of platinum 0.65 mm. thick and measure 3.5 mm. by 15 mm. They are attached to a semimalleable 18 gage wire, 14 cm. in length. The radon is inserted into the nasopharynx much as is a nasopharyngoscope; the two capsules (totaling 150 millicuries on the first day) are passed along the floor of the nose and then separated by placing a small piece of rubber tubing over the insertion wires outside the nostril (figure). They are left in place twenty-six minutes the first day. Since 150 millicuries is equivalent to 150 mg. of radium element, twenty-six minutes gives a dosage of 66 milligram hours or 2 gram minutes; i. e., approximately the dosage recommended by Crowe.[1] The radon capsules as a rule lie very near any exuberant lymphoid tissue on the medial side of the torus tubarius. For convenience they are considered as a single source of examination in estimating dosage. However, since the capsules are separated, the total effect of 66 milligram hours would not reach any area in the nasopharynx. The designation "66 milligram hours" therefore slightly exaggerates the dose that actually reaches the nasopharyngeal walls. The exact dose delivered to the tissue is not known since the applicators necessarily lie at different distances from the tissue in different persons; so the strengths of the two applicators added together and the time that they lie in the nasopharynx are used as yielding the most reasonable and safest approximation of the dose.

Since radon loses one half of its strength each three and eighty-five hundredths days, the time is increased every day until there is little activity left in the radon, i. e., not over ten days (table 1). The treatments were originally given at intervals of six weeks until 4 to 6 doses had been given. There was rarely any evidence of improvement until after the third treatment. If a patient had a cold or active otitis at the time of his appointment for treatments, one-half the usual dose was given, i. e., 33 instead of 66 milligram hours. Then, if no reaction occurred, a second dose of 33 milligram hours was given in two or three days. Occasionally there was increased stuffiness in the ears without objective signs

1. Crowe, S. J., and Baylor, J. W.: The Prevention of Deafness, J. A. M. A. **112**:585 (Feb. 18) 1939.

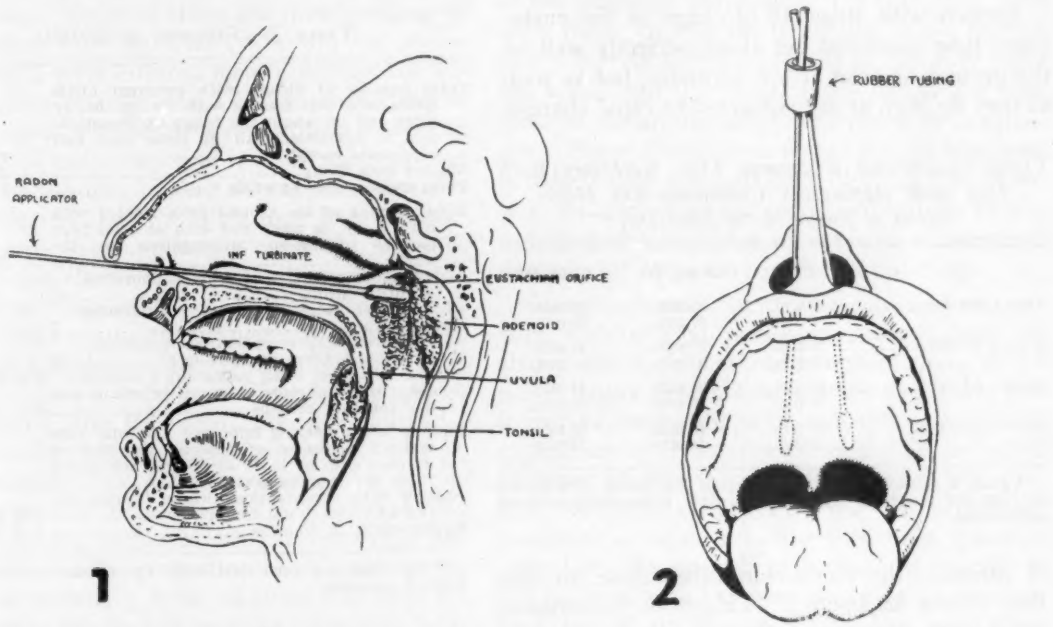
2. Fowler, E. P., Jr.: Non-Surgical Treatment for Deafness, Laryngoscope **52**:204 (March) 1942.

3. (*a*) Fisher, G. E.: Recognition and Radium Treatment of Infected Lymphoid Tissue, Arch. Otolaryng. **37**:434 (March) 1943. (*b*) Jones, E. H.: Irradiation of the Nasopharynx in Office Practice, ibid. **37**:436 (March) 1943. (*c*) Farrior, J. B.: Histopathologic Considerations in Treatment of the Eustachian Tube, Arch. Otolaryng. **37**:609 (May) 1943.

following treatment, but twice in patients with active nasopharyngitis it was observed that definite acute catarrhal otitis media with fluid levels developed. Myringotomy was not needed in these cases, and the fluid disappeared in a few days. When the interval between treatments was reduced to three weeks, there were no untoward results. This was expected, for much more extensive irradiation of involved areas is given to patients with neoplasm without permanent effect on normal tissue. In a small series of patients 100 milligram hours was tried at intervals of four weeks for four treatments. The results in these patients have not yet been sufficiently followed up for inclusion in this paper, but the method seems to be satisfactory.[4]

less it was suppurative. Even when suppuration cleared there was in many cases residual catarrhal otitis following the use of sulfonamide compounds. This seemed to be particularly so if the dosage was inadequate or if the sulfonamide drug was not given for a sufficiently long period, or if the adenoids were very large.

Experience with high voltage roentgen rays [2] has shown that they affect hyperplastic lymphoid tissue in the nasopharynx much as does radon, but patients must take many more treatments. The therapy takes longer and the roentgen rays are more difficult to apply accurately to the region of the eustachian tube; they are more likely to involve surrounding tissue and produce other



1, position of one of the applicators in the nose and the nasopharynx. *2*, diagram of the relative position of the two applicators in place as seen from below.

Shrinkage of the nasal mucosa, even temperature and sunny weather would undoubtedly have helped some of the patients treated with radon, but most of them had been extensively treated without relief before being sent to the Second General Hospital. Some of our airmen went to Africa, and they were quite well until they came back. Succeeding attacks were often more persistent and resulted more often in suppuration than first attacks. Sulfonamide compounds rarely had any effect on the disease unsymptoms, such as mild parotitis, erythema of the skin or dryness of the throat. Radium element, on the other hand, can be used if available. The 25 or 50 mg. capsules often used in gynecologic practice are convenient for this work.[2]

The greatest difficulty in the Army has been to get the men back by appointment for enough treatments. They feel better and they do not come until their symptoms recommence, or they move so that they are no longer evacuated for sickness to the original hospital before the course is finished. Many have been sent back to the United States because their nasopharyngitis or sinusitis seemed to be uncontrollable in this theater. These are the reasons so many of the patients of this type have received incomplete treatment in our hands.

4. Since this article was submitted it has been found that the use of 100 milligram hours with filtration through 0.65 mm. of platinum at four week intervals is much more satisfactory than the use of 66 milligram hours at 3 week intervals. Often two treatments were sufficient, although three were usually necessary and four were given to maintain what improvement occurred.

In those patients who have received a sufficient number of treatments with adequate dosage and who are not plagued by chronic nasopharyngitis and sinusitis there has been a gratifying percentage of successes (table 2).

Unfortunately, many medical officers and patients expect too much from the treatment. Radiation is not a "cure for deafness". It obviously will not improve the hearing much if scars and adhesions interfere with the movement of the ossicles. It cannot be expected to work if chronic sinusitis repeatedly bathes the orifices of the tubes with pus and reinfects the middle ears, or if chronic purulent otitis is present, although at times it does seem to help patients with this condition. It rarely is of benefit if severe allergic rhinitis is present.

Airmen with subacute blockage of the eustachian tube can often get along perfectly well on the ground or even at low altitudes, but as soon as they fly high or are subjected to rapid changes

TABLE 1.—*Increase in Dosage Time Necessary Each Day with Applicators Containing 150 Millicuries of Radon on the First Day* *

		66 Mg. Hr.	100 Mg. Hr.
June 1, 1st day.....	10 a.m.	26 min.	39 min.
	4 p.m.	27 min.	42 min.
June 2, 2d day.....	10 a.m.	31 min.	47 min.
	4 p.m.	33 min.	51 min.
June 3, 3d day.....	10 a.m.	38 min.	57 min.
	4 p.m.	40 min.	60 min.
June 4, 4th day.....	10 a.m.	45 min.	68 min.
	4 p.m.	48 min.	72 min.

* Such a table is made up each time the radon is delivered so that the proper dosage for each date is available without calculation.

of altitude, the eustachian tubes close so that they cannot be opened. This otitic barotrauma produces conditions varying from a mild catarrh of the middle ear to acute, severe otitis with or without rupture, and the involvement may even go on to an acute purulent process. None of these conditions would develop if the eustachian tubes had not functioned poorly in the first place. Most of the malfunction of the tubes is due to swollen tissue within them. This tissue is not always apparent at the orifice. In addition to lymphoid tissue, there are often swollen glands and edematous mucosa or submucosa, as well as hypersecretion, blocking the tube. The cold air of high altitudes often causes hypersecretion in the nose, and the secretion bathes the tubal orifices and blocks or irritates them. Apparently radiation reduces the activity of the glands, shrinks the edematous tissue and has, in addition, a specific effect on hyperplastic lymphoid tissue. It is probable that the radiation even has a beneficial effect on the infection present.

Some physicians assume that adenoids are rare in adults. American soldiers after a few months in England often have so much excess lymphoid tissue that as soon as the mouth is opened this tissue can be seen bulging from the posterior pharyngeal wall or behind the posterior tonsillar pillars in heavy bands. It is particularly prominent following an attack of a virus bronchopneumonia. When it can be seen on the pharyngeal wall below the palate, it is invariably present in the nasopharynx above. It is often difficult in the military forces to obtain the smooth narrow metal tongue blade and the small well silvered mirror and good lighting necessary for proper indirect examination of the nasopharynx; likewise, it is often difficult to obtain a good naso-

TABLE 2.—*Summary of Results*

Total number of airmen with recurrent otitis media who were treated with 200 mg. hr. or more and on whom the follow-up investigation is complete. (All of these men had aero-otitis except 3)	29	
Number back flying	23,*	or 79%
Total number free of otitis media	28,	or 96%
Total number of the ground force treated with 200 mg. hr. or more and with at least four months' follow-up investigation in the winter	59	
Number with recurrent nonsuppurative otitis media	40	
Number with recurrent suppurative otitis media	7	
Number with complications (otosclerosis in 3, nerve deafness in 9)	12	
Number free from otitis media for 4 months	35 of 47,	or 75%
Number whose chronic suppurative otitis was dry for four months	3 of 7,	or 41%
Number whose hearing improved and who were without recurrence of deafness and had an average gain of 15 to 40 db. for the speech range for four months	40 of 54,	or 74%
Number with complications whose hearing improved 15 to 20 db. for low notes	3 of 12,	or 25%
Improvement in tinnitus	3 of 7,	or 41%

* One pilot has been shot down by the enemy after several combat missions.

pharyngoscope with a wide field and an upright image for direct examination. If they are used in every case, it is surprising how many soldiers are observed to have large lymphoid masses in and about the cartilaginous portions of their eustachian tubes. Of 2,337 new patients in the ear, nose and throat clinic with which I am associated, well over one third had swollen lymphoid tissue in the nasopharynx. Radon treatment was begun in 220 of these. A summary of the results is given in table 2. Other details are as follows: Twenty-four underwent adenoidectomy because radon rays do not sufficiently reduce large masses of hyperplastic lymphoid tissue in the midline in the dosage given. Of the 2,337 patients, 62 have been fliers, pilots, navigators, bombardiers, gunners, with recurrent otitis due to barotrauma sufficiently severe for them to be sent for special treatment. Nine of these have been sent back to the United

States after one or two treatments because, in addition to otitis, they had intractable nasopharyngitis or sinusitis. A few have been lost at follow-up. The remainder are still under treatment. Seventy-nine per cent of the airmen who have had sufficient treatment are back on full flying status (table 2); i. e., 79 per cent of airmen who have had two or more episodes of severe difficulty in clearing their ears are now quite comfortable and have not been grounded for two months or more. Most of them before treatment had aerotitis after every flight. None of the flyers had much residual deafness by the time they reached a general hospital, so that it is difficult to give a graphic picture of their improvement. However, the fact that they are now flying several times per week without trouble is significant. Some of them are dive bombing in fast planes. Of the 6 men who did not return to flying, 2 were enlisted men, grounded for administrative reasons, and 2 had a residual nerve type deafness sufficiently severe to keep them from passing the examination of hearing necessary for return to the air. Their nonsuppurative otitis media cleared, but the high tone loss did not. The chronic nonsuppurative otitis did not subside completely in 1 patient, although he was able to carry on in ground duty. One had had severe recurrent nasopharyngitis in this theater and was boarded to the United States. It is probable that he could have flown here could he have stayed after the treatments were finished.

As for the control group (ground personnel), the results are not quite so clearcut. It is difficult to be sure that some of the 75 per cent who stopped having recurrent otitis media would not have got well without treatment. It is also probable that eventually some of them will have recurrences. Almost five years of experience with treatment of recalcitrant disease of the upper respiratory tract and secondary otitis media in this and other hospitals makes one certain clinically that radiation is the treatment of choice if adenoid tissue on the lateral nasopharyngeal walls blocks the eustachian tubes. There is also no question that if only subjects without active severe nasopharyngitis or sinusitis had been selected, the percentage of improvement would have been better. The ones who had otosclerosis or nerve deafness were treated because these conditions are diagnosed with difficulty and occasionally some improvement is obtained even when these conditions are present. This is believed to be due to the subsidence of superimposed tubal catarrah. In spite of the fact that no accidents have occurred with the relatively safe dosage used, it is believed unwise and dangerous for an otolaryngologist to attempt radiotherapy of the nasopharynx without the continual guidance of a qualified specialist in radiotherapy. On the other hand, when such control is available, treatment of the lymphoid tissue about the eustachian tube with radon or radium is simple, easily learned and relatively inexpensive. It is infinitely more efficacious and the effects more permanent than those of catheterization, politzeration or bougienage. These should be reserved for the few cases in which they are indicated (Farrior [3c]). Centers for the more extensive utilization of the radiation treatment for hyperplasia of lymphoid tissue in the nasopharynx should be set up.

A report is made at this time because experience with ground personnel and children has shown that hyperplasia of lymphoid tissue in the nasopharynx predisposes to otitis media and that it can be controlled with radiation. A limited experience of flying personnel shows, as might be expected, that this modality also tends to prevent recurrent otitis media due to barotrauma (aero-otitis) when it is due to swollen tissue in and about the eustachian tubes. In practice it has put men who had been previously grounded, back in the air able to fight. We need them there, NOW!

Capt. Paul M. Osmun, Medical Corps, Army of the United States, assisted in the examination and treatment of the patients, and Lt. Col. Robert P. Ball, chief of the Radiology Service, Second General Hospital, in the details of radiotherapy.

Case Reports

CHRONIC SUPPURATIVE MAXILLARY SINUSITIS TREATED LOCALLY WITH PENICILLIN BY A NEW METHOD

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AND
CAPTAIN EDWARD H. DIAMOND
MEDICAL CORPS, ARMY OF THE UNITED STATES

Penicillin has undoubtedly been used locally in sinusitis by many physicians. However, since a patient treated by us evidenced such remarkable improvement, it is felt that a report of the case and the method may be of interest.

REPORT OF A CASE

The patient was treated on foreign duty in an Army station hospital where reference to any great amount of literature is impossible. The use of penicillin was based on the excellent and comprehensive information found in the War Department Technical Bulletin no. 9, issued Feb. 12, 1944, which is prepared by the Surgeon General and distributed to all medical officers of the Army.

The patient was first seen at an outpost, complaining that he had been troubled with nasal obstruction and copious purulent discharge for the past seven or eight years and that the condition had become worse in the past four months. "Examination of his nose revealed that the septum was deviated to the right, with 40 per cent obstruction. There was a large mass of polyps on the left, covered with purulent discharge." Polypectomy was performed with some relief of symptoms. Several irrigations of the antrum did not reduce the flow of pus, however, and the patient was finally transferred to this station.

Examination at this time revealed a large, husky 31 year old private with marked deviation of the septum to the right. There was purulent drainage from the right middle meatus but no evidence of polyposis. On the left there was copious thick purulent drainage with a mass of polyps filling the middle meatus. Roentgenograms revealed "radiodensity of both maxillary antrums significant of chronic maxillary sinusitis. The membranes are thickened and demarcation is absent peripherally." General physical examination revealed no abnormalities except bilateral scars of herniorrhaphy. The results of the laboratory studies were normal; the white blood cell count was 10,900 with 75 per cent neutrophils and no increase of eosinophils.

Both antrums were irrigated, with return of pus from both sides. Cultures of the secretions of the nose and the contents of the antrums grew a gram-positive type of Staphylococcus aureus as the predominant organism. Bacteriologic studies were made by direct smear and by culture on blood agar and in broth. Radiopaque oil was placed in the antrum, and further roentgen studies were made. The roentgenograms (*A* and *B* in the figure) revealed marked filling defects on both sides. The shadow on the right was interpreted as representing hypertrophied mucosa; that on the left was significant of severe polypoid degeneration of the mucosa.

Penicillin therapy was then instituted in the following manner: Spinal puncture needles were introduced, one into each antrum, and allowed to remain in place for twenty-four hours. A solution of penicillin was prepared in sterile isotonic solution of sodium chloride so as to contain 1,000 units per cubic centimeters (1 ampule of 100,000 units dissolved in 100 cc.). Five cubic centimeters of this solution was injected into each antrum every three hours for eight doses. The stilet was replaced in the needle immediately after each injection, and the patient was kept in an upright position so that the solution would remain puddled in the antrums. *E* in the figure shows the needles in place with the radiopaque oil puddled in the antrums, in the manner described for penicillin.

The patient experienced no unpleasant reactions and immediately felt generally improved. On the third and fourth day he blew out numerous fragments of polypoid tissue. On the sixth day after the therapeutic procedure the nose was almost free of purulent discharge. Submucous resection with removal of the remaining polyps in the left middle meatus was performed. No packs were placed in the nose postoperatively.

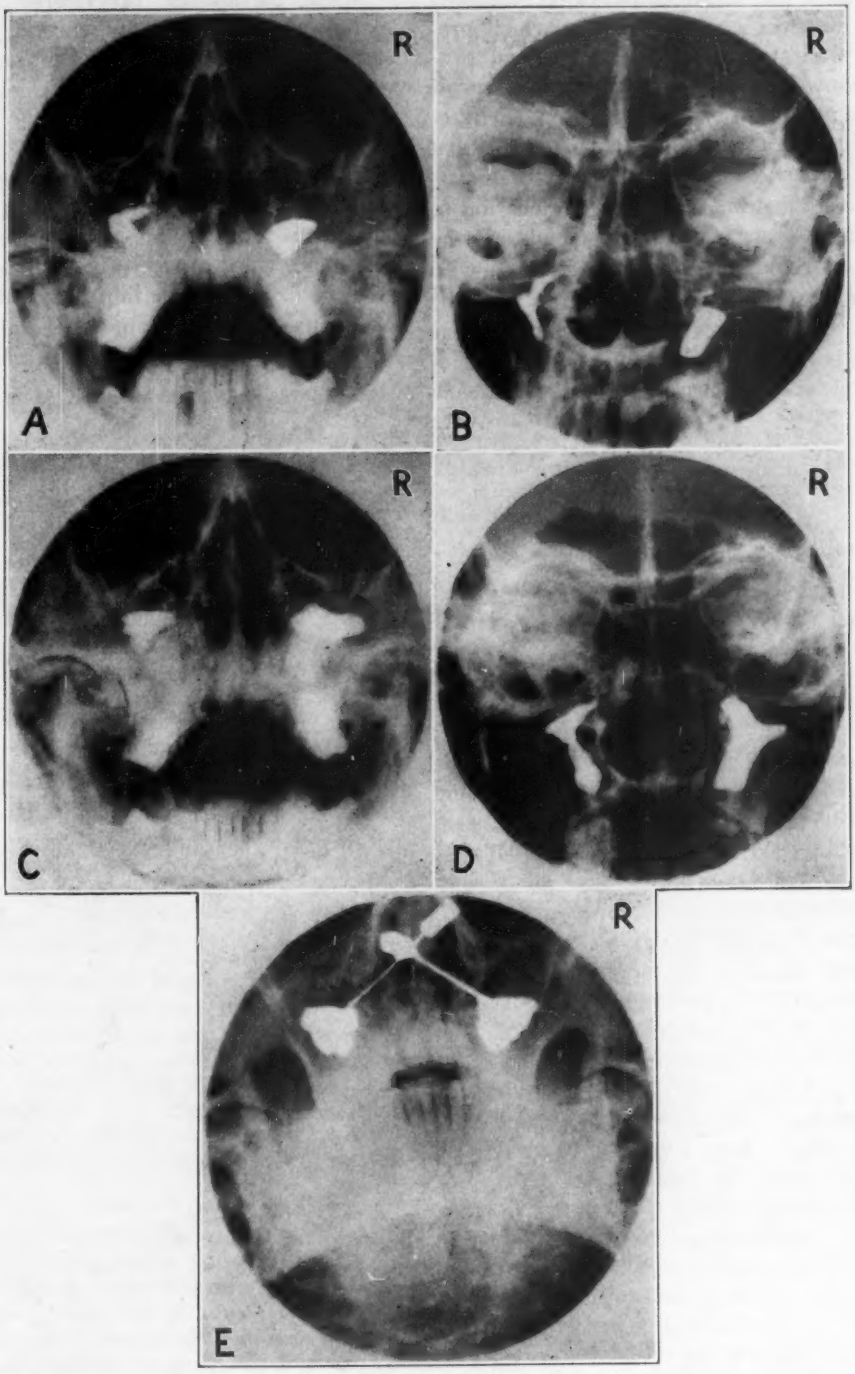
Six days later cultures of the nasal secretion revealed no growth. The antrums were irrigated and their contents cultured. Gram-positive Staphylococcus aureus and Staphylococcus albus were isolated from the left antrum along with a moderate amount of blood-tinged purulent secretion. Roentgen studies with radiopaque oil were again made. These revealed considerable reduction in the filling defect on both sides. The twenty-four hour treatment with penicillin was repeated.

Seven days later (nineteen days after the first application of penicillin) the antrums were irrigated, with return of clear fluid. Cultures of both nasal cavities and both antrums revealed no growth of any organisms whatever. Contrast roentgenograms were again made (*C* and *D*). It will be noted that in both Laws and the Waters position the filling defect of the right antrum is within normal limits whereas that in the left is much reduced over *A* and *B* in the figure, although there is still evidence of hypertrophied mucosa.

The patient was under observation for fifteen days further, during which time there was no evidence of a return of purulent sinusitis.

COMMENT

This case was one of long-standing purulent bilateral maxillary sinusitis with severe poly-



A and *B*, Waters and Laws positions with radiopaque oil in the antrums before treatment. The filling defect on the right demonstrates a smooth outline with a smooth meniscus superiorly. This indicates edema or hypertrophy of the mucosa without polypoid degeneration. The shadow on the left indicates a marked filling defect with an irregular outline. This is interpreted as an indication of polypoid degeneration of the mucosa.

C and *D*, the same views nineteen days later, after two courses of special penicillin therapy and submucous resection. Before the radiopaque oil was placed in the antrums, cultures of material from the nasal cavity and the antrums were made, which proved to be sterile. The filling of the right antrum is within normal limits. In the left antrum the filling defect is markedly reduced and is considered to be compatible with adequate physiologic aeration.

E, view demonstrating the puddling of the penicillin in the antrums, represented by radiopaque oils with the closed spinal puncture needles in place.

posis in which the usual conservative methods of therapy were of no avail, a case which presented the indications for radical surgical procedures. However, by combining minor surgical therapy and local use of penicillin such remarkable improvement was demonstrated that the soldier returned to full duty, thereby obviating expensive and time-consuming evacuation to the continental United States. By rendering the chronically infected antrums bacteria free with penicillin and establishing normal aeration of the sinuses by surgical treatment the mucosa has been permitted to approach the normal physiologic state.

These therapeutic procedures are not presented as a cure-all for chronic sinusitis but merely as a new method of utilizing penicillin which deserves further trial.

SUMMARY

In a case of severe chronic bilateral maxillary sinusitis with polyposis of long duration a special method of applying penicillin therapy combined with conservative surgical treatment resulted in remarkable improvement.

The use of penicillin in the therapy of sinusitis is felt to be worthy of further trial.

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Progress in Otolaryngology

Summaries of the American and British Bibliographic Material Available in the Field of Otolaryngology

TONSILS AND ADENOIDS

J. DUDLEY SINGLETON, M.D.

DALLAS, TEXAS

In reviewing the American and British literature from Oct. 1, 1942 through December 1943, one finds a continued decrease in the number of articles published. However, in spite of this scarcity, a number of worth while articles have appeared. Several authors have described or compared various technics for the removal of the tonsils. Tumors of the tonsils, both benign and malignant, have attracted the attention of others. A number of articles deal with the nasopharynx.

TONSILS

General Considerations.—Tamari and Berman,[1] in a practical and well written paper, discuss various factors that influence the duration of acute tonsillitis. They briefly report several cases to emphasize some of the various factors.

The article is well summarized in its concluding paragraphs as follows:

> In summing up all that has been said, it appears clear that the normal reaction of the tonsil to an inflammation depends upon the state of the mucosa, the connective tissues and the normal arrangement of the follicles. In cases where the mucosal lining loses its permeability or where the connective tissue fails to absorb the toxic material and where the reticuloendothelial system is disarranged the normal defensive setup is destroyed.
>
> #### SUMMARY
>
> Our investigation has shown that acute tonsillitis with prolonged duration is epidemic at certain periods of the year when there is a sudden change of air pressure and temperature. Other factors such as general debilitating disease and anatomical anomalies such as elongated styloid processes or embryonic cartilage remains also extend the duration of acute tonsillitis. Specific bacterial characteristics such as that demonstrated by the pneumococcus and the traumatisms of the mucosa and incomplete surgical procedures which alter the normal mucosal state also are responsible for the extended course.
>
> Menstruation not only increases the incidence of acute tonsillitis, but also during this time the angina is more severe and healing takes place more slowly.
>
> Superimposed infections delay the defensive action of the follicles and the vascular system; while secondary degenerations such as cysts, obliteration of the lacunae and the lymphatic tissue all aid in prolonging resolution.
>
> Insufficient irradiation either by x-ray or radium which does not destroy the adenoid tissues but alters the structure of the tonsillar organ also prolongs the clinical course of acute tonsillitis.

McCormick[2] reviews the literature on the coincidence of tonsillectomy and poliomyelitis with special reference to the recent multiple familial cases reported by Krill and Toomey. He calls attention to the work of Stuckey, who found that many of the children from the Kentucky mountain region had enlargement of the tonsils, adenoids and lymph glands. Their diet was deficient mostly in the B vitamins, and in most of the cases the lymphatic hypertrophy was found to be amenable to nutritional correction. McCormick states that on the same basis the lymphatic reaction in poliomyelitis may serve as an index of vitamin B deficiency which, according to his hypothesis, may be an etiologic factor in this disease. A recent survey of Toronto's 1937 cases of poliomyelitis showed a ratio of 3.68 per thousand among the population on relief diet, as compared with 0.94 per thousand in the remaining population. It was also found that less than 8 per cent of the city's total population provided more than 60 per cent of the city's total postoperative cases of bulbar poliomyelitis. The possible relation of anesthesia to postoperative poliomyelitis is discussed in considerable detail. The author calls attention to the fact that changes which occur in the central nervous system as a result of anoxia during general anesthesia are quite similar to the changes characteristic of poliomyelitis. He suggests that "the virus may actually be of endogenous origin—a biochemical by-product of disturbed carbohydrate metabolism (vitamin B deficiency), capable of reproducing in laboratory animals a similar disease process by means of catalytic chemical action in the central nervous system."

1. Tamari, M., and Berman, A. M.: Factors Influencing the Duration of Acute Tonsillitis, Illinois M. J. **84**:269-272 (Oct.) 1943.

2. McCormick, W. J.: Tonsillectomy and Poliomyelitis: A New Concept of Etiological Relationship, M. Rec. **156**:164-167 (March) 1943.

Paton [3] presents a detailed study of 909 school girls over a period of ten years, 1930-1939; 516 had been operated on and 393 had not. By comparing the two groups and using the no operation group as a control approximating normal he hoped to provide data which would indicate the effect of operation as regards future health. As a result of his studies, he states that the following facts are indicated:

1. The operation group was no healthier than the control group on arrival at school.

2. The operation group was less healthy than the control group while at school. This is best shown by the number of school days lost through illness.

3. The operation group suffered less from tonsillitis.

4. The operation group suffered much more from respiratory infections, and lost more days from bronchitis alone than they gained in respect to tonsillitis.

5. When the small groups in whom a single operation was performed (tonsil operation, 57 cases, adenoid operation, 24 cases) are considered certain deductions are warranted.

(*a*) Removal of the tonsils is the factor in the combined operation responsible for the reduction in tonsillitis and for the increase in respiratory infections.

(*b*) Removal of adenoids appears to be followed by certain definite effects. Adenoidectomy alone reduces the liability to respiratory infections, but it is evident that in the combined operation group the removal of adenoids failed to counteract the increase in respiratory infections which resulted from the tonsillectomy. Removal of adenoids increases the liability to acute otorrhoea. The evidence, put forward in some detail, shows that recurrent attacks of otorrhoea are seldom prevented and primary attacks of otorrhoea are more frequent after the operation.

CONCLUSIONS

The figures put forward support the conclusion of Glover and Wilson (1932), arrived at from a survey of more than 14,000 records, that a large proportion of the tonsil and adenoid operations now done in children are 'unnecessary, entail some risk, and give little or no return.'

The figures also show that removal of tonsils increases the susceptibility to respiratory infections, and that the adenoid operation is followed by increased susceptibility to middle ear inflammation.

They corroborate Glover's (1938) assertion that a great reduction in the operation rate 'would be followed by no unsatisfactory result and, it may be, by actual benefit.'

Negus [4] describes two types of acute tonsillitis and states that the two types are known as acute "parenchymatous" and "follicular" tonsillitis. Prominent, projecting tonsils tend to parenchymatous inflammation, whereas submerged tonsils are more liable to follicular infection. The incidence is highest in the age groups from 10 to 30 years. It is rare in very young persons and in persons past 50 years. Incomplete removal of the tonsils is a predisposing cause. The infection is common during epidemics of measles and scarlet fever, and occasional attacks are seen in cases of diphtheria. Hemolytic streptococci and to a less extent pneumococci are the usual causative organisms. Malaise, pyrexia, thirst, pains in the limbs and back, fulness in the throat, pain on swallowing and earache due to referred pain are given as common symptoms of the disease. Acute tonsillitis must be differentiated from diphtheria, scarlet fever, measles, lymphatic leukemia and agranulocytosis. In cases of an uncomplicated form the prognosis is good, and in one to three weeks the patient should be well.

In the treatment of acute tonsillitis the patient should be isolated in bed. Purgatives, antipyretics and salicylates are recommended; acetylsalicylic acid and sedatives are given for pain; chemotherapy and local treatments are advised. Acute rheumatic infections, otitis media, acute lymphadenitis, septicemia, peritonsillar abscess, infection of the parapharyngeal space and hemorrhage are discussed briefly under the heading of complications.

Victor [5] reports the local use of sulfanilamide following tonsillectomy. The technic is described as follows:

. . . Immediately after the removal of the tonsils a small amount of sulfanilamide powder was held in firm contact by means of a sponge in both the right and the left tonsillar fossa simultaneously for five minutes. Eight hours after the operation a thin layer of sulfanilamide powder was applied directly into the fossa with the aid of a powder blower. The patient was instructed to hold the breath during this procedure so as to avoid coughing. Twenty-four hours after the operation a similar procedure was again carried out. Thereafter the patient was allowed to resume the usual postoperative routine.

Not more than 5 Gm. of the drug was used in each fossa in each of the three procedures; it was used in children and adults following induction of either local or general anesthesia. Twenty-five patients were studied. They showed less postoperative oozing, fewer positive blood cultures in the first twenty-four hours after operation, less inflammatory reaction and more rapid healing than was observed in a similar group of 25 patients not treated with sulfanilamide.

3. Paton, J. H. P.: The Tonsil Adenoid Operation in Relation to the Health of a Group of School Girls, Quart. J. Med. **12**:119-128 (April) 1943.

4. Negus, V. E.: Acute Tonsillitis: Diagnosis, Treatment and Complications, Practitioner **150**:1-6 (Jan.) 1943.

5. Victor, K. N.: Local Use of Sulfanilamide in Tonsillectomies, Arch. Otolaryng. **37**:438 (March) 1943.

Ditkowsky, Stevenson and Campbell [6] report an epidemic of rheumatic fever in a children's school following an outbreak of acute tonsillitis. They summarize and conclude the article as follows:

. . . Two hundred forty-one children had acute hemolytic infections of the throat, while 88 children in the institution showed manifestations of rheumatic fever. The conclusions reached after studying various features of the epidemic are:

1. The epidemiology of rheumatic fever is closely linked with that of streptococcic infections of the upper respiratory tract.

2. Familial predisposition on the basis of specific tissue susceptibility probably is an important factor in the pathogenesis of rheumatic fever.

3. The most susceptible age group appeared to be between 9 and 14 years. Sex did not appear to be a factor.

4. Sixty-two children (65 per cent) had histories compatible with previous rheumatic infections. Sixty-one children had systolic apical murmurs elicited before the present rheumatic attack, most of them having the characteristics ascribed to functional murmurs. This would suggest that the murmurs should be observed repeatedly before they are dismissed as insignificant.

5. No direct correlation could be made between meteorologic conditions and the incidence of rheumatic fever. It was felt that they were important so far as they were related to the seasonal incidence of infections of the upper respiratory tract.

Kelemen [7] reports at length a study of the palatine tonsils as observed in the sixth decade of life. He summarizes the article as follows:

Involution in the palatine tonsils is an atrophic process, more precisely a numerical atrophy. Cells and tissues decrease in number without degeneration, and show no signs of change to any lower or functionally less active form before their final disappearance.

The capsule remains well outlined behind even the last remnant of the organ and thereby offers a plane of cleavage. Thus, enucleation in old age is a comparatively simple procedure. Bone, cartilage, and cyst formations are neither more nor less than they are in younger age groups. Septa and submucous connective tissue do not undergo any conspicuous hyalinization or transformation into elastic elements. There is no "senile fibrosis" in the tonsil.

Connective and lymphatic components disappear in equal proportion and the preponderance of one or the other corresponds merely to constitutional types observable at any age (parenchymatous or fibrous tonsil.)

The epithelium shows shifting as the cryptal lining comes to cover the free surface after eversion. Even in this changed location the cryptal epithelium maintains its characteristically high grade of reticulation and remains sharply demarcated from the original epithelium of the free surface. The crypts contain their inclusions as long as they are not transformed from deep channels into open, shallow depressions.

The lymphatic parenchyma maintains, until its final disappearance, the function which was the first to appear in prenatal life, that of sending lymphocytes and leukocytes through the epithelium with reticulation of the latter. Cellular and basal-reticular constituents remain unchanged in form and activity, even in those last isolated blocks of lymphatic tissue which have already lost their differentiation into secondary nodules and their contact with any cryptlike structure.

Scarcity of thromboses in veins and of perivascular infiltrations in the retrotonsillar space accounts for the infrequency of local reactions around the receding tonsil. At the same time, with parenchymal activity unchanged, focal reactions appear at distant parts of the body, as they do at any age.

The grade of recession is generally the same on both sides. In the vast majority of the involuted group, tonsils may be found in all stages of development in the sixth decade. They demonstrate a tonsillar life cycle which is apparently independent of that of the organism as a whole. The impulse to start the involution is as unexplained in the tonsil as in any other organ. To attribute it to physiological aging or to describe it as a result of a pathological process remains pure speculation.

The double vascular mechanism of the retrotonsillar cavernous plexus with ridge-like structures in its arteries may be responsible for temporary changes in size at any age as well as for the definite closing off of the blood supply, which results in the final atrophy of the organ.

Podboy [8] favors the use of cotton suture material (a no. 60 black thread) in tonsillectomy because of its inexpensiveness, the simplicity of its sterilization, the ease of handling and the small danger of infection. It is sterilized by boiling from ten to twenty minutes and is used while wet. He states that wounds sutured with cotton produce less reaction and heal sooner than those sutured with silk, linen or catgut.

Technic.—Morey [9] describes a technic for local tonsillectomy which he claims is completely bloodless in 90 per cent of the cases in which it is used. He injects a large amount of procaine hydrochloride with a small amount of epinephrine hydrochloride into the "so-called tonsillar capsule," which acts in three ways: It prevents all pain, it acts as a perfect hemostatic, and by its quantity alone the tonsil is forced from its bed by an intervening layer of edematous tissue.

The preparation of the patient and the injection of the tonsils are described by the author in detail as follows:

Preparation of Patient.—About forty-five minutes before the operation the patient is given morphine gr. ¼ and atropine gr. 1/100. Ten minutes before, while the patient is still in his room, the throat is sprayed by an assistant with equal parts of 10% cocaine and adrenaline

6. Ditkowsky, S. P.; Stevenson, E., and Campbell, J. M.: An Epidemic of Rheumatic Fever in a Children's Institution (Following an Outbreak of Acute Tonsillitis), J. A. M. A. **121**:991-995 (March 27) 1943.

7. Kelemen, G.: The Palatine Tonsil in the Sixth Decade, Ann. Otol., Rhin. & Laryng. **52**:419-443 (June) 1943.

8. Podboy, A. J.: Cotton Suture Material for Tonsillectomy, Arch. Otolaryng. **36**:743 (Nov.) 1942.

9. Morey, G. W.: Bloodless Tonsillectomy Under Local Anesthesia, Lancet **2**:794-796 (Dec. 25) 1943.

1/1000. (When he comes to the operating theatre, the patient may complain of a lump in the throat and that he cannot swallow properly, but this is the maximum discomfort he is likely to feel.)

Injection.—With the patient seated on an ordinary chair, facing the operator, who sits on a slightly higher level, the throat is now injected. As this is the most important part of the whole operation, the operator should wear a powerful and properly focused headlight. A suitable syringe and needles should be used. A 20 c.cm. Record syringe with movable thumb and finger rings is best, for the point of the needle may then be turned in any direction without alteration of grip. The needles should be reinforced, about 5 in. long, and curved almost to a right angle at the tip, and they should have some locking device on the tip of the syringe (Galbraith's haemorrhoidal needle is suitable).

Five injections, each of 5 c.cm. of ½% novutox (a preparation of procaine hydrochloride containing 0.00002 Gm. per cubic centimeter), are made into each tonsil area; in this low dilution 50 c.cm. is quite harmless. The first injection is made at the top of the anterior pillar, about 1 cm. from the margin, with the tip of the needle pointing downwards and slightly outwards. The second is made in the middle of the pillar, 1 cm. from the free border, with the needle pointing directly downwards. The third, and most important, is made at the junction of the anterior pillar and base of the tongue, the needle point being directed downwards and inwards. For the fourth injection the point of the needle is inserted behind the posterior pillar as high as possible and in an upward direction, the syringe being drawn over into the opposite angle of the mouth. The fifth injection is made behind the posterior pillar as low as possible, the point of the needle being directed downwards and outwards, with the syringe drawn well over into the angle of the mouth.

The technic of the operation is clearly described. This article is well worth reading. I have used a similar technic, with less injection, for years with satisfactory results.

Griffin [10] briefly reviews the anatomy and the blood supply of the tonsils and stresses the importance of keeping away from the tonsillar bed in dissecting out the tonsil, which is best done by pulling it forcibly toward the midline while carrying out the dissection. One-half hour before the operation morphine sulfate and atropine sulfate are given hypodermically. About fifteen minutes before the operation a solution of tetracaine hydrochloride (2 per cent) is sprayed into the throat. For local anesthesia a 1 per cent solution of procaine hydrochloride with 8 drops of a 1:1,000 solution of epinephrine hydrochloride to the ounce (31 cc.) is injected into two places, about 1 cc. being used for each injection; a third injection may be given if there is a history of peritonsillar abscess.

The tonsil is grasped at the superior and inferior poles with a long grasping forceps and is drawn toward the midline; the mucous membrane is then incised at the middle third between the plicas with curved scissors. The blades of the scissors are then inserted between the mucous membrane and the capsule and opened widely. After freeing the upper pole, the tonsil is grasped with another tenaculum through the incision in the capsule. The first tenaculum is removed and the tonsil is pulled downward and medially and separated from its attachment with a serrated modified Hurd operator. The removal of the tonsil is completed with a snare.

Jobson [11] compares the guillotine technic with the dissection technic for the removal of the tonsils of children and adults. He states that one must be endowed with a fine touch and good muscular coordination and must have long practice to attain a high degree of perfection in the use of the guillotine instrument. In operations on children he favors the use of the guillotine instrument, but in operations on adults, he states, the dissection method is the one of choice.

Whitney [12] reports a study of the results of 216 tonsillectomies done over a period of twenty-six months. He compares the results obtained by the use of an "automatic" mechanical instrument with those obtained by the dissection and snare technic. In the use of the "automatic" instrument he advises grasping the infratonsillar nodule at the lower pole of the tonsil with an Allis forceps and clipping a slight nick at the base of the tongue distal to all evident lymphoid tissue. By starting the mechanical instrument at this point the infratonsillar nodules are removed along with the tonsils.

Whitney states that the operation can be done more quickly and with less bleeding at the time of the operation when the mechanical instrument is used.

Hilgartner [13] states that electrocoagulation of tonsils has long been discarded as a routine method of removing tonsils but that the method is indicated in certain cases as follows: in cases of nephritis, diabetes, tuberculosis and in cases in which the removal of tonsillar tags is planned. The author lists three charts that show the results obtained in 80 cases in which electrocoagulation was used.

Tumors.—Simpson and Graham [14] call attention to the fact that malignant melanoma is of interest because of its extremely high mortality and bizarre metastasis. In a survey of the literature they found no case of primary malignant

10. Griffin, E. A.: Tonsillectomy by Eversion, Eye, Ear, Nose & Throat Monthly **22**:98-100 (March) 1943.

11. Jobson, T. B.: Tonsillectomy by Guillotine and Dissection, Brit. M. J. **2**:512-513 (Oct. 31) 1942.

12. Whitney, H. H.: Tonsillectomy Versus Tonsillectomy: Report of 216 Cases, J. Florida M. A. **30**:18-19 (July) 1943.

13. Hilgartner, H. L.: Electrocoagulation of Tonsils, Dis. Ear, Nose & Throat **2**:312-313 (Oct.) 1942

14. Simpson, W. L., and Graham, D. G.: Metastatic Melanoma of the Tonsil, Laryngoscope **53**:160-163 (March) 1943.

melanoma of the tonsil. New and Childrey, Lewis, and Hart and Crawford have reported single cases of metastatic melanoma of the tonsil. All 3 patients died within a few months.

The authors report the case of a woman 58 years of age, who was first seen in May 1942. She complained of hematemesis of about two weeks' duration. A bronchoscopic examination resulted in a positive diagnosis of melanoma. A black-pigmented mole had been removed from the patient's back on July 12, 1941, with a microscopic diagnosis of malignant melanoma. The patient was admitted to the hospital on July 8, 1942, complaining of weakness. Examination showed a glistening purplish black tumor about 2 to 3 cm. in width in the left tonsillar region. There was generalized cervical adenopathy. Roentgenograms of the chest showed multiple areas of involvement throughout the thoracic area. The tonsil and tumor were removed, with the patient under general anesthesia, without disturbing the attached tumor. The microscopic diagnosis was melanoma of the tonsil. The patient died Aug. 19, 1942. Autopsy showed malignant melanoma involving the right bronchus, the lungs, the heart, the intestinal tract, the spleen, the pancreas, the adrenal glands, the mesenteric nodes, the mediastinal nodes, the skin, the right tonsil and the cerebral cortex.

The authors summarize their report as follows: "In a survey of the literature, three cases of metastatic melanoma of the tonsil were found and we are adding the fourth. All reported cases were bilateral."

Whitcomb [15] in discussing sarcoma of the tonsil cautions against confusing it with carcinoma of the anterior faucial pillar. Carcinoma of the pillar is a slowly growing tumor, which seldom metastasizes beyond the regional lymph glands of the neck. It kills by pain and starvation. Sarcoma of the tonsil grows rapidly, spreads quickly and widely and kills by visceral metastasis.

Six of the 7 patients seen by the author had a mass just below and behind the angle of the mandible. The typical mass is described as large, deep and immovable and is probably a tumor of the lower pole of the tonsil, but it may consist of a tumor of the tonsil and superimposed lymphadenopathy; this type of mass is so constant as to form the most characteristic clinical feature of the disease.

In making the diagnosis, sarcoma of the tonsil must be differentiated from the various lymphoblastomas of the tonsil and from other types of malignant tumors. In the treatment of the local lesion and its metastases roentgen rays and radium or a combination of the two are recommended. The prognosis in cases of sarcoma of the tonsil is poor. The patients die of widespread metastasis.

Hanckel [16] reports a case of bilateral polyp of the faucial tonsils. The patient, a white man 38 years of age, was admitted to the hospital April 22, 1942, complaining of a feeling of discomfort in the throat and a productive cough of four years' duration. He had lost about 20 pounds (9 Kg.) in weight during the past six weeks. Examination of the throat showed an ovoid tumor measuring about 1 by 2 cm. attached to the superior pole of the left tonsil by a broad base; the tumor extended medially to the uvula. It was firm and was smooth and glistening in appearance. There was no enlargement of the cervical nodes. The tonsils were removed under local anesthesia. Microscopic examination of the tumor revealed that it was a fibrous vascular polyp. A similar tumor was found in the substance of the right tonsil. The patient made an uneventful recovery and was relieved of his symptoms.

Laub [17] reports a case in which a tonsillar polyp was observed in a Negro woman 59 years of age. The patient complained of difficulty in swallowing and talking for about one year. The condition had gradually grown worse. Examination revealed a tumor about the size of an orange protruding from the left tonsil. The tumor was movable and was attached by a pedicle about 1.5 cm. long by 0.75 cm. wide. Adjacent lymph glands were enlarged. The tumor and pedicle were removed completely under local anesthesia. The gross and the microscopic appearance are described in some detail. A diagnosis of tonsillar polyp was made. The article contains nine references.

THE NASOPHARYNX

Jones [18] describes and illustrates a radon applicator designed for office use which contains 100 millicuries of radon and can be shipped by express. Its use for office treatment has proved satisfactory, and the cost is reasonable. It is manufactured by the Radium Emanation Corporation, New York.

Leath [19] briefly describes the anatomy of the nasopharynx and points out that it can be easily

15. Whitcomb, C. A.: Sarcoma of the Tonsil: Impressions Made by Seven Cases, Arch. Otolaryng. **38**: 1-9 (July) 1943.

16. Hanckel, R. W.: Bilateral Polyp of the Faucial Tonsils: Report of a Case with Review of the Literature, Arch. Otolaryng. **37**:563-564 (April) 1943.

17. Laub, G. R.: Tonsillar Polyp, Arch. Otolaryng. **36**:729-734 (Nov.) 1942.

18. Jones, E. H.: Irradiation of the Nasopharynx in Office Practice, Arch. Otolaryng. **37**:436-438 (March) 1943.

19. Leath, M. B.: The Significance of the Nasopharynx, North Carolina M. J. **4**:53-55 (Feb.) 1943.

and thoroughly examined by the use of a nasopharyngoscope and a mirror. A large portion of his discussion is devoted to adenoids. He advises direct inspection of adenoids before operation when possible. For adenoids that have been incompletely removed Leath recommends radiation therapy, which usually gives good results. Surgical removal of adenoids may be accomplished with the patient under local or general anesthesia. The operation should be performed with the patient's head well back, and suction should always be used.

Fisher [20] calls attention to the changes that occur when lymphoid tissue is exposed to roentgen rays and radium. He then describes in detail the instrument he uses in treating lymphoid tissue in the nasopharynx, also the technic of application. He reports good results in 100 patients treated with the radium applicator and concludes:

> Chronically infected and hypertrophied lymphoid tissue in the nasopharynx causes obstruction of the orifices of the eustachian tubes and is constantly covered with a thick, tenacious discharge. Atrophic changes can be readily produced in this tissue by exposing it to the gamma rays of radium.

In stressing the importance of complete adenoidectomy Cassidy [21] points out that the symptoms which called for the operation will not be relieved if the procedure is inadequate, that damage to important structures may result from unskilled surgical procedures, that new symptoms may arise as a result of incomplete removal and that necessity for secondary operations reflects on the original operator and on the medical profession as a whole. He discusses briefly the adenoid as a site of focal infection producing remote symptoms such as fever and headache. The instruments necessary for complete adenoidectomy are listed, and the technic of the operation is described in detail.

Langer [22] in a study based on careful hearing tests and otolaryngologic examinations of 1,365 school children, whose ages ranged from 8 to 14 years, endeavored to show relationships of impaired hearing to information easily obtained in mass examinations. The study was made with the thought that such correlations might aid in diagnosis or prognosis and be of practical value in large scale programs for the prevention of deafness. The author's discussion and summary follow:

> It may well be that some easily observed physical or "constitutional" conditions are related to the incidence of impaired hearing in children or to the effectiveness of irradiation therapy of the naso-pharynx, and a search for them should be continued. So far as the present study shows, however, no information of practical importance in a program to prevent deafness in children is afforded by consideration of height or weight for the age, by shape of head or of face, or by the condition of the teeth.

2514 Oak Lawn Avenue.

20. Fisher, G. E.: Recognition and Radium Treatment of Infected and Hypertrophied Lymphoid Tissue in the Nasopharynx: Preliminary Report, Arch. Otolaryng. **37**:434-436 (March) 1943.

21. Cassidy, W. A.: Importance and Method of Doing a Complete Adenoidectomy, J. Mid-West Clin. Soc. **4**:58-60 (April) 1943.

22. Langer, E.: Impaired Hearing in Children and Size of Adenoids in Relation to Some Anthropometric Data and to Condition of Teeth, Ann. Otol., Rhin. & Laryng. **51**:931-935 (Dec.) 1942.

Abstracts from Current Literature

Ear

TREATMENT OF EXTERNAL OTITIS: I. LOCAL SULFONAMIDE THERAPY. BEN H. SENTURIA, Laryngoscope **54**:277 (June) 1944.

External otitis is an important disease in the warmer climates. The causative organisms are probably a mixture of both bacteria and fungi. The bacteria may be various kinds of streptococci, staphylococci, diphtheroids and Bacillus pyocyaneus. The fungi may be spores of Penicilla, Aspergillus and Monilia. They are saprophytic fungi. True pathogenic fungi are rarely found.

Fungi need carbohydrates for their growth. They flourish in ear wax. Moisture is necessary for them to obtain close contact with their source of energy. Toxins are produced by the growth of the fungi. These irritate the surface epithelium. The bacteria present then invade this irritated epithelium.

Signs and symptoms vary from a feeling of blockage, dryness, itching, scaling, or slight tenderness on manipulation of the external canal to varying amounts of pain, edema of the wall of the canal, glandular swelling and slight fever.

In treatment, a mixture of sulfanilamide, sulfathiazole and zinc peroxide powders (4:2:2) was found most efficacious. It was blown into the ear after it had been cleaned mechanically and with hydrogen peroxide.

The patients were seen daily for several days. Sedation was given as necessary. As the condition improved, irrigation with sodium bicarbonate solution was used to wash out all the accumulated debris and powder. Irrigation was done only when the edema and the tenderness had subsided enough to permit drying of the canal afterward. This was followed with instillation of alcohol. In several minutes this was allowed to run out. The residuum in the canal soon evaporated. Powder was then reapplied and left in for a week. The patient was cautioned against getting water into or about the ears, and swimming was forbidden.

In all the cases of acute infection the condition responded well, only 1 case in 33 requiring more than seven days for a complete cure. No recurrences were observed. In other cases, as a control, treatment was by dry wipes, alcohol and sulfanilamide in alcohol. In these the condition did not respond so quickly and some recurrences were noted. Auditory acuity was unaffected.

HITSCHLER, Philadelphia.

A SECOND STUDY IN THE AFFECTIVE VALUE OF SPEECH SOUNDS. JON EISENSON, JEROME FISHER and SYLVIA G. SUCHER, Quart. J. Speech **29**:457 (Dec.) 1943.

In this study 69 deaf subjects, of whom 34 had congenital defects in hearing but had been taught oral speech, were questioned as to whether they considered certain speech sounds pleasant or unpleasant. Both persons with normal hearing (from a previous experiment) and deaf persons reacted to most isolated speech sounds as being pleasant. Both normal and deaf persons agree that "z," "j," "th," hard "g," "zh" and "wh" are unpleasant sounds.

PALMER, Wichita, Kan. [AM. J. DIS. CHILD.]

A CASE OF ACUTE OTOGENOUS LABYRINTHITIS AND MENINGITIS. MAXWELL ELLIS, Lancet **1**:468 (April 8) 1944.

Ellis reports the case of an airman aged 18 who was successfully treated with sulfapyridine for labyrinthitis and meningitis not due to nonhemolytic streptococci. Recovery was eventually complete except for absolute deafness and loss of labyrinthine responses on the affected side. The author emphasizes the need for fearless use of the drug to achieve entire freedom from infection. If the bone marrow is coincidentally depressed, a large blood transfusion, repeated as often as necessary, is both a rational and a safe antidote. It is practical to concentrate on elimination of the infection and to worry about changes in the blood if and when they occur.

McCARTER, Philadelphia.
[ARCH. NEUROL. & PSYCHIAT.]

Pharynx

FACTORS INFLUENCING THE DURATION OF ACUTE TONSILLITIS. M. TAMARI and ALEX M. BERMAN, Illinois M. J. **84**: 269 (Oct.) 1943.

The analysis of a large number of cases of acute tonsillitis at the Illinois Charitable Eye and Ear Infirmary disclosed that changes of season not only increased the number of cases but prolonged the duration of acute tonsillitis and increased the number of complications.

Other conditions which decrease the general resistance and prolong the duration of acute tonsillitis are rickets, anemias, tuberculosis and other debilitating diseases. Streptococci and pneumococci are mostly responsible for acute tonsillar infections. Local conditions extending an attack of acute tonsillitis are chronic infections of the teeth and the mouth, chronic sinusitis and chronic infections of the larynx, the trachea and the bronchi.

Swabbing, painting and washing of the crypts, as well as suction of the tonsils during acute attacks, are mechanical therapeutic efforts which retard the normal healing process. Infections of stumps or larger tonsillar remains are marked by more painful and more prolonged duration. Another factor influencing the normal course of acute tonsillitis is incomplete radium or roentgen therapy.

BARBOUR, Peoria, Ill. [AM. J. DIS. CHILD.]

THE DIAGNOSIS AND TREATMENT OF LUDWIG'S ANGINA. ASHBEL C. WILLIAMS and WALTER C. GURALNICK, New England J. Med. **228**:443 (April 8) 1943.

The mortality in the present series was 10 per cent, compared with 54 per cent in an earlier one.

In the previous report the source of the infection appeared to be dental in 51 per cent of the cases. It was surprising to discover that a dental lesion was apparently the initiating factor in 18 (90 per cent) of the present series.

Streptococci have long been known to predominate as the causative organisms in Ludwig's angina. The presence of other organisms that grow best anaerobically has been mentioned previously.

The authors have been unable to control the disease in any instance by treatment with sulfonamide drugs alone.

It is recommended that the trachea be exposed or tracheotomy completed with local anesthesia. This having been done and an airway or a potential airway thus assured, pentothal sodium should be administered intravenously and the incision and drainage carried out while the patient is anesthetized with the latter drug. Oxygen should be administered nasally during the second phase of the procedure.

GENGENBACH, Denver. [AM. J. DIS. CHILD.]

Larynx

LESIONS OF THE ESOPHAGUS IN GENERALIZED PROGRESSIVE SCLERODERMA. JOHN R. LINDSAY, F. E. TEMPLETON and STEPHEN ROTHMAN, J. A. M. A. **123**: 745 (Nov. 20) 1943.

Five patients with clinically and histologically typical generalized progressive scleroderma presented evidence of a disturbance of the swallowing mechanism, varying apparently only in the stage of the esophageal lesion. There was roentgenologic evidence of disturbed function of the esophagus in all 5 with a varying degree of stenosis in 3.

The esophageal disturbances were characterized by loss of peristalsis in the lower two thirds of the esophagus, difficulty, especially when in the lying position, in swallowing solids or liquids, burning pain behind the sternum about an hour after meals, chronic ulceration in the lower third of the esophagus and stricture formation in the later stages, limited to the region immediately above the phrenic ampulla of the esophagus.

Esophageal biopsy specimens revealed changes in the connective tissue of the submucosa which suggested sclerodermatic change.

On the basis of the observations in these 5 consecutive cases, the authors believe that disturbance of esophageal function is characteristic of generalized progressive scleroderma.

HENSCHEL, Denver. [ARCH. DERMAT. & SYPH.]

CONGENITAL CYST OF THE LARYNX. JANE I. DAVIDSON, Lancet **2**:508 (Oct. 23) 1943.

Congenital cyst of the larynx is rare. It may manifest itself at birth or give rise to no symptoms until adult life. The cyst which causes symptoms at birth is commonly fatal if not promptly recognized. Cure by simple aspiration has been reported. The diagnosis can be made by laryngoscopy or by palpation.

Only 15 cases of the condition in infants have been reported.

A case is reported in which the patient, an infant, died on the twenty-fourth day of life. At autopsy a cystic swelling about 5 mm. in diameter was found on the left wall of the larynx, almost completely occluding the orifice.

LANGMANN, New York. [AM. J. DIS. CHILD.]

SUFFOCATING LARYNGITIS. S. GONZALEZ AGUIRRE, B. MESSINA and R. REY SUMAY, Rev. Soc. puericult. Buenos Aires **9**:242 (July-Sept.) 1943.

A review of the literature on suffocating laryngitis is presented.

The causation, pathogenesis and clinical picture of the condition are discussed. The authors state the belief that the menthol present in "Vick's Vaporub" plays an important role in the production of laryngospasm by aggravating the general condition. Ten cases of suffocating laryngitis are presented; 5 patients died. The use of various therapeutic measures and medicaments, including intubation, tracheotomy, direct tracheobronchial aspiration through the endoscope, steam, sulfanilamide and derivatives of it (administered locally and generally), antispasmodics (phenobarbital or aconite) and calcium gluconate (administered intravenously) is discussed.

The use of opium, which suppresses the cough reflex, or of belladonna, which dries up secretions, making difficult their expulsion, is contraindicated. In all 10 cases diphtheria toxoid-antitoxin was used.

BRIBIESCA, Mexico. [AM. J. DIS. CHILD.]

Nose

THE LYMPHATIC DRAINAGE OF THE PARANASAL SINUSES. FRED W. DIXON and NORMAND L. HOERR, Laryngoscope **54**:165 (April) 1944.

The authors feel that infection reaches the bronchi and the lungs from the sinuses by way of the respiratory passages. Their work tends to disprove the theory that infection is carried to the lungs by other routes (lymphatics, lymphatic vascular or lymphatic tissue space). They studied living rabbits and unembalmed human cadavers. India ink was injected into the mucosa of the sinuses, and its progress along the lymphatics was noted. Detailed descriptions are given.

HITSCHLER, Philadelphia.

ORBITAL CELLULITIS IN A BABY CAUSED BY ACUTE OSTEOMYELITIS OF THE MAXILLA. J. A. MAGNUS, Brit. J. Ophth. **28**:135 (March) 1944.

A girl aged 2 weeks had had a cold with nasal discharge. There was proptosis of the eyeball with edema of the lids. Within two days the clinical picture was that of orbital cellulitis. On the fifth day after admission to the hospital an incision was made through the medial part of the left lower lid down to the bone. A large subperiosteal abscess of the floor of the orbit was opened, and excessive pus was discharged from the opening. A small fistula persisted, and about three months later a sequestrum, measuring 8 by 10 mm., was removed by forceps. The fistula then closed, and further progress was uneventful.

The article is illustrated.

ZENTMAYER, Philadelphia. [ARCH. OPHTH.]

Miscellaneous

THE SIGNIFICANCE OF EOSINOPHILIA IN RHINOLOGY. DANIEL MILLER, Ann. Otol., Rhin. & Laryng. **53**:74 (March) 1944.

The list of local and general conditions in which eosinophilia occurs is so long and so varied that it offers not a single suggestion as to the function of these cells. However, eosinophilia observed in the nasal secretions or in the blood in the presence of certain generally known symptoms has usually been associated with allergy. Miller discusses the occurrence of histamine, which is released in the breakdown of proteins of the body. Histamine produces a remarkable constrictor effect on smooth muscle, such as that in arterioles and bronchioles, and produces a dilator effect on capillaries. The latter reaction causes stagnation of the blood in the areas of reaction and thus produces edema. He refers to the research of C. F. Code which seems to indicate that the probable function of the eosinophils is

to carry histamine away from the tissues. Histamine is rendered inert by an enzyme called histaminase.

M. V. MILLER, Philadelphia.

A CASE OF CAVERNOUS SINUS THROMBOSIS. P. D. TREVOR-ROPER, Brit. M. J. **1**:255 (Feb. 19) 1944.

A boy aged 14 years struck the region of his left eyebrow on a door handle. Two days later, as the area became sore, he attended the hospital, but nothing was apparent except a slight abrasion of the skin. The following day the eye began to protrude, and he had a temperature of 103 F. The condition rapidly grew worse; on the following evening the other eye was equally proptosed, and on the day after the whole face was swollen. He was then vomiting, was incontinent and became semicomatose. This condition lasted one week, with the temperature about 103 F.; he then gradually recovered. On the fifth to the eighth day tremors affected all the muscles of the face and the arm on one or both sides. The only changes in the fundus were slight engorgement of the retinal veins and possible blurring of the margin of the optic disk. On his return to consciousness there was paralysis of the left side of the face, which cleared in about a fortnight. There were stiffness of the right leg and paresis of the left external rectus muscle, which disappeared in a few days. Convalescence was delayed by mild basal pneumonia and a small subcutaneous orbital abscess. Vision was 6/5 in each eye.

Treatment included the administration of sulfapyridine, which could be given only intramuscularly after the second day, and then oral use of sulfadiazine, 32 Gm. the first week and 21 Gm. the second week. Administration of 4 pints (1,890 cc.) of 5 per cent dextrose in isotonic solution of sodium chloride, given as drip transfusions, was necessary while he was incontinent, vomiting and unable to take fluids by mouth.

In 1936 cavernous sinus thrombosis had a 100 per cent mortality. Since the advent of sulfonamide compounds, cures have been reported in 12 cases. In 3 cases, in conjunction with sulfathiazole, heparin was used for the prevention of extension of the clotting; in addition, staphylococcus antitoxin is recommended, even when the blood culture is sterile.

The author believes that the infection in this case reached the orbit from a nasal sinus through a fracture of the intervening bone, although this could not be shown on roentgenographic examination. (The abrasion of the brow was quite sufficient to serve as a portal of entrance for the infection and was a much more probable source than the nasal sinus [abstracter].) The meningeal irritation and residual palsies are a frequent accompaniment. Retinal changes have rarely been severe in the cases in which recovery occurred.

KNAPP, New York. [ARCH. OPHTH.]

ASEPTIC CAVERNOUS SINUS THROMBOSIS WITH RECOVERY. H. S. LE MARQUAND and E. C. RECORDON, Lancet **1**:247 (Feb. 19) 1944.

Le Marquand and Recordon report the case of a man aged 29 who received a hard blow over the right eye from a soccer ball, resulting in a momentary blackout. Six days later he had a sore congested pharynx; hemolytic streptococci were grown from material from the throat, and he was given sulfapyridine (8 Gm.). Five days later he had signs of bilateral thrombosis of the cavernous sinus, the temperature not reaching over 99.4 F. then or later and no meningeal signs appearing. Sulfapyridine and sulfathiazole were given (10 and 15 Gm., respectively), and three days later the signs started to subside. Cultures of the blood and spinal fluid were negative, as was the urine.

The authors did not feel that a completely satisfactory explanation was possible. Either the blow to the head or the infection of the throat caused rapidly spreading thrombosis. One month after the original trauma recovery was complete except for some residual retinal disturbance in the right eye.

MCCARTER, Philadelphia.
[ARCH. NEUROL. & PSYCHIAT.]

Society Transactions

MASSACHUSETTS EYE AND EAR INFIRMARY

R. L. Goodale, M.D., *Editor*

Selected Cases Reported at the Regular Weekly Clinical Meetings from January to March 1943

Acute Otitis Media with Epidural Abscess and Meningitis. Presented by Dr. H. G. Tobey, Dr. Philip Mysel, Dr. A. S. MacMillan, roentgenologist, Dr. C. S. Kubik, neuropathologist, and Dr. Daniel Miller, Resident. (This case was reported Jan. 6, 1943.)

Dr. Daniel Miller: This patient is a 5 year old girl who was admitted to the Massachusetts Eye and Ear Infirmary on Dec. 11, 1942, approximately three weeks ago, with a chief complaint of otorrhea on the left side, apparently of five weeks' duration, accompanied by fever and chills. She had had previous acute attacks of otitis media in this ear, in 1937, 1938 and 1939, all of which subsided.

On examination there was tenderness over the tip and the antral region of the mastoid process. The culture was reported to show beta hemolytic streptococci. Sulfadiazine therapy was started. The discharge began to diminish. However, two or three days after admission to the hospital the patient became apathetic and did not respond to questions. Her temperature rose to 104 F. She had nuchal rigidity and Kernig's sign. The spinal fluid showed 1,702 white cells per cubic millimeter, of which 90 per cent were lymphocytes and 10 per cent were polymorphonuclears. The initial pressure was 275 mm. of mercury. The smear revealed no organisms. The blood cultures were negative.

At this time the question arose whether there was a perforation from the tegmen into the dura which was producing the meningitis or whether tuberculosis or an epidural abscess, or possibly an abscess of the brain was present.

Roentgenograms of the chest revealed a healed tuberculous node in the left upper part of the chest corresponding to the region of the first rib. The tuberculin test, however, was negative.

During the next few days the temperature gradually came down to 99.6 F., and it stayed there for twelve days. The administration of sulfadiazine was discontinued ten days after admission and eight days after the onset of the meningitis. At this time the middle ear was dry and the drum membrane intact. After the acute meningeal signs had thus subsided, it was thought best not to investigate the mastoid process, but the possible necessity of this procedure was borne in mind, and the patient was kept in the hospital for a longer period of observation. At two of three subsequent lumbar punctures the spinal fluid revealed 120 cells, and at the third, 50 cells; the lymphocytes were still 90 per cent.

On January 2, after two weeks of normal temperature and no positive signs, the temperature went up to 104 F., and the patient again had severe frontal headache, nuchal rigidity and Kernig's sign. The Tobey-Ayer test was negative; the spinal fluid contained 3,456 cells, and the initial pressure was 415 mm. of mercury. This time the cell count showed 79 per cent polymorphonuclears and 21 per cent lymphocytes. The patient was operated on that day.

Dr. Philip Mysel: When we first saw this patient we considered, for the differential diagnosis, lymphocytic meningitis, tuberculous meningitis, epidural abscess and possibly abscess of the brain. The patient had been having a little fever. Her ear was practically dry when I saw her the day after admission. She had few postaural signs, and the roentgenograms showed a small mastoid process with sclerosis. Two days afterward meningeal signs developed; she had a little stiffness of the neck, and at lumbar puncture the spinal fluid contained many lymphocytes. Roentgenograms of the chest showed healed pulmonary tuberculosis.

The chemical study of the spinal fluid at that time had not been reported. Later on it was stated to show normal levels of chlorides and sugar and an increase in proteins. The cultures of the spinal fluid were negative. After chemotherapy had continued for ten days, the use of the sulfonamide drug was stopped in order not to mask any neurologic signs.

There was no marked change for about ten days and then suddenly some real meningeal signs developed. These were a raging frontal headache, marked stiffness of the neck and a high temperature. A lumbar puncture was done, and the fluid was cloudy, consisting mainly of polymorphonuclears.

She was taken to the operating room, and the mastoid process was explored. Nothing was found in the mastoid process itself; it was small, underdeveloped, and had few cells in it. The antrum contained no granulations. There was no secretion in it. The lateral sinus was exposed by operation and was normal. The tegmen was intact, but it was only after removing the tegmen that one saw an area of pathologic change. In this area were some yellowish granulations which extended onto the external surface and down onto the inferior surface of the temporal lobe. There was no free pus. The whole tegmen was removed flush with the superior petrosal sinus so that there was good exposure of the dura. We found normal dura above and in front and underneath after we exposed the region of the petrosal sinus. In other words, we had before us an enclosed epidural abscess. The postaural wound was left open, the patient was put back to bed, and chemotherapy was reinstituted.

The next day the patient was still pretty sick. She had a severe headache and was vomiting. The question arose whether to do any more than we had done the day before. My reaction was to leave the involved area alone and treat the patient for meningitis. However, after consulting one of the senior surgeons, we decided to incise the epidural abscess, as there might be a subdural abscess which should be drained. The mass of granulations covered an area the size of a 25 cent piece, and in one portion of these granulations there was a yellowish area about the size of a green pea. I cut through the area of granulations; I obtained no pus but I had opened what appeared to be a small cavity with granulations. I thought it might be a cortical abscess. This area presented granulations of the same type as those on the outside of the dura. I put in a small rubber dam drain between the dura and the granulations, and put the patient back to bed.

We have been treating this little girl with chemotherapy. She has had a transfusion. The meningitis is subsiding. She has no headache this morning, no stiff neck, no vomiting. She has no aphasia and no localizing signs of any kind. She has had no nystagmus, ocular signs or facial paralysis, and it is just a question whether the dura should be incised or not. Dr. Kubik is here. I should like him to discuss this case.

DR. C. S. KUBIK: I saw the patient the other day and again today and find no abnormal neurologic signs except, perhaps, a little nystagmus when she looks to the left, which is not much in itself. It is a curious type of cerebellar reaction: so many cells, with such a high percentage of lymphocytes. With a cell count that high and a fairly subacute process one would expect a large percentage of polymorphonuclears. One cannot always rule out bacteremic meningitis in spite of the fact that the sugar and chloride levels are normal and the cultures negative. It takes a while sometimes to get positive cultures, but the other tests do not agree with that either. I might say that we have had other patients with a pathologic process similar to this, with epidural granulations, in which apparently the infection was trying to get through into the subarachnoid space and produced a cellular reaction—what one might call aseptic meningitis.

A number of years ago a girl was admitted here during the season of poliomyelitis and we thought she had poliomyelitis. An infection of the middle ear was present, a similar number of cells was counted in the spinal fluid, I think 300 to 500; there were mild symptoms of meningitis. Her condition remained pretty much on a level for two or three weeks, and then real meningitis developed and she died. In that case we found a large granulomatous mass extending through into the subarachnoid space.

Then there was a patient whom Dr. Tobey observed, with intracranial infection that came through the ethmoid bone. That patient had several attacks of meningitis and a purulent spinal fluid. Most of the cells were polymorphonuclears, but there were no pathogenic organisms in the first two or three weeks. Then he finally got an "honest to goodness" bacteremic meningitis and died.

I suppose something of the same sort is going on here, and apparently there was something on the inner side of the dura, too, because of its proximity to the subarachnoid space, setting up that reaction, whatever that is to be called.

DR. H. G. TOBEY: Is the pachymeningitis simply a stage in the development of the subdural abscess?

DR. C. S. KUBIK: I suppose it may be a stage, that is, in the subdural infections. In many of them one finds epidural granulations, and those no doubt have been there sometime before the process actually went through the dura. And in some cases in which there are not epidural granulations, in which there is a perforation of bone, as in cases of infection of the frontal sinus with a perforation of the posterior wall, one may not find a defect in the dura and yet the infection has come through it, through the subdural space and, in some cases, into the subarachnoid space.

DR. PHILIP MYSEL: Will you tell us a few symptoms and signs of subdural abscess? How do you make your diagnosis of subdural abscess? Do you see it without localizing signs?

DR. C. S. KUBIK: In the early stage, yes; before localizing signs, of course, it is difficult to diagnose. We have studied 12 or 13 cases and in all but 1 the subdural abscess was a complication of a sinus infection. In only 1 case did it complicate an aural infection. In cases in which it complicates an infection of the frontal sinus the development is as follows: There are orbital swelling and localized headache, which becomes generalized and persists that way for awhile, and then rather quickly, in from two to ten days, the patient becomes much worse, the temperature rises and eventually becomes high, 102, 103, 104 or 105 F., and the patient shows signs of increasing intracranial pressure, with drowsiness, which stays; he becomes increasingly stuporous, goes into coma and shortly dies. About the same time that he becomes drowsy or stuporous, focal signs develop. He invariably has stiffness of the neck. With the onset of the focal signs, one can usually make the diagnosis and explore.

Now as to the spinal fluid findings in those cases—all the patients had leukocytosis. The count was not high as a rule; in 1 case it was 100; in 1 case it was 1,000; generally it was 300 to 400, and yet there was a very stiff neck. There is this disproportionate picture between the spinal fluid and the stiffness of the neck. In the cases with autopsy we found the pus most abundant in the region of the lateral sinus, and we think that this was the logical place to explore, because the pus was most abundant there and also because it gave one a clear view of the dura, and it was possible to see the pus through the dura. Rarely is it necessary to open the dura to make the diagnosis. There would be no harm in opening through a clear field to see if there was pus underneath. However, the dura was exposed here at a previous operation, and with the epidural granulations it was impossible to see what was underneath. I don't believe this girl has a subdural abscess; she has improved so much, we can be reasonably sure that she has not.

(This patient has been followed for ten months after operation and has done extremely well.)

Chronic Suppurative Otitis Media and Cerebellar Abscess on the Left Side. Presented by DR. H. G. TOBEY, DR. A. S. MACMILLAN, roentgenologist; DR. JOST MICHELSEN, neurosurgeon; DR. DANIEL MILLER, resident. (This case was reported Feb. 9, 1943.)

A white woman aged 37 came here on Nov. 16, 1942, with a chief complaint of earache on the left side of six days' duration and dizzy spells, nausea and vomiting for one day. Her left ear had been discharging for eighteen years. On admission to the hospital no neurologic signs were noted. However, because of the labyrinthine disturbance she was put to bed, and four days later, November 20, the first stage of a radical mastoidectomy was done. At operation cholesteatoma was found about the antrum. The patient was put back to bed, and one week later, on November 27, the second stage of the radical operation was done. At this stage granulations were cleaned out, and a small fistula was found in the lateral semicircular canal. The patient did quite well for eleven days.

On December 8 she had slight paralysis of the left side of the face, and the discharge from the mastoidectomy cavity became a little more profuse. She was watched closely for the next few days, and six days later her temperature suddenly rose to 105 F. A lumbar puncture was done, and the initial pressure was 700 mm. of mercury. The spinal fluid showed 3,000 cells per cubic millimeter, mainly polymorphonuclears. The patient kept her head turned to the right. The facial weakness had become more complete at this time, and

that night the patient was operated on again. The radical mastoidectomy was revised, and labyrinthectomy was done. The dura of the middle fossa was exposed by removing the tegmen. The lateral sinus plate was removed. The dura of the middle fossa was thick and tense and covered with granulations. The lateral sinus was covered with dark granulations. The facial nerve was uncovered for an area of about 2 cm. below the horizontal semicircular canal. The cerebellar dura was found to have been involved by the disease process. An area of necrosis about 2.5 cm. in size, from which a seropurulent fluid exuded, was noted over the cerebellum. Because of the patient's condition no further surgical work was done, and she was returned to the ward. Following this, the course was stormy. She was given sulfadiazine and two transfusions. The temperature gradually came down. The patient began to be more rational and seemed to be doing quite well.

The neurologic consultation on December 22 revealed no nystagmus. The paralysis of the left side of the face was noted, and there was definite deficiency in the performance of rapid movements of the left hand.

On January 1 the patient complained that severe headache followed the last lumbar puncture. The initial pressure at this time was only 150 mm. of mercury, with only 50 cells in the spinal fluid; the severe headache developed despite the improvement indicated by the spinal fluid. It was mainly frontal in type. There was definite weakness of the muscles of the left arm and the left leg. There was papilledema for the first time, 1 diopter in the right eye and 2 diopters in the left eye. The neurologic consultants again were called in. On their advice the patient was transferred to their service, where she was observed for a day.

On January 4 exploration of the left side of the cerebellum was done by the neurosurgical service, and an abscess was found from which about 15 cc. of pus was aspirated. A colloidal suspension of thorium dioxide was injected into the abscess cavity, and roentgenograms were taken. The observations were reported as follows:

"Skull: There is a cavity filled with the contrast suspension, measuring approximately 4 cm. in diameter. It is more or less pear shaped. It lies posterior to the left petrous portion, the neck of the pear coming close to the posterior aspect of the midportion of this bone. The superior border of the cavity apparently lies in contact with the tentorium. The area of contrast substance does not change in shape with different positions of the patient.

"The observations are those of an abscess just below the left petrous portion, the abscess cavity being completely filled with the colloidal suspension of thorium dioxide."

DR. JOST MICHELSEN: This cerebellar abscess has been treated so far by tapping only. It was tapped four days ago. When we operated on the patient for the first time we believed that we should fill that cavity with a contrast substance to be sure of the location of the abscess. We got 13 cc. of pus, which was cultured and reported to show hemolytic streptococci. Ten days later (January 14) we again tapped the cavity.

The clinical course was favorable since the patient showed definite improvement in the cerebellar signs, and we felt that little more should be done. However, she still showed adiadokokinesis. On January 22 we tapped the abscess again and got about 20 cc. of pus. Yesterday, February 8, we again aspirated the abscess and did not find pus. We found cloudy fluid, which so far has not shown any bacteria on microscopic examination or on culture. (Pictures of the abscess as it looked before the last procedure were shown.) Here is the postoperative picture, which is particularly striking, as it shows that the cavity has become much smaller, while here the abscess extends far toward the midline. Here a collapse of the cavity has taken place.

On March 18 closure of the mastoid wound was performed.

(Follow-up note, Feb. 18, 1944: This patient eventually recovered, although she still has paralysis of the left side of her face. At present there is facial symmetry when the face is at rest, but the paralysis is noted when she shows her teeth or attempts to smile. She has few headaches. The fundi are normal. The cavity from the radical mastoidectomy is dry and well healed.)

Acute and Chronic Osteomyelitis of the Frontal Bone. Presented by DR. G. H. POIRIER, DR. A. S. MACMILLAN, roentgenologist, and DR. J. R. RICE, resident. (This case was reported Feb. 24, 1943.)

A 12 year old girl was admitted here on Jan. 12 1943, with a chief complaint of swelling of the right eye for one day. She had been perfectly well and normal until about three months before admission. Then a severe head cold developed, and since then she had a continuous postnasal discharge. She felt weak at night. She had had no actual symptoms until four days before admission, when severe frontal headache, vomiting and extreme malaise developed; she had had no chills or fever. The day before admission there was swelling of the right eye, with edema over the right side of the forehead.

On admission the headache and the vomiting had disappeared. She had a temperature of 102 F. There were edema and marked tenderness at the root of the nose and over the right side of the forehead. The right eye was closed. The nasal mucous membrane was inflamed. Thick greenish pus was coming from both middle meatuses. She had a postnasal discharge. The neck was not stiff. A culture of the pus showed Staphylococcus aureus. The white blood cell count was 9,400, 85 per cent of which were polymorphonuclears. Roentgenograms had been taken in Dr. MacMillan's office before her admission.

DISCUSSION

DR. A. S. MACMILLAN: On the left side of the frontal bone there was an area that looked like osteomyelitis. The left maxillary antrum and also the ethmoid cells on both sides were filled with acutely infected membrane.

DR. J. R. RICE: Sulfadiazine therapy and the usual local treatment were started. However, she remained sick, with a septic temperature. Two days after admission she was operated on, under ether anesthesia. A straight horizontal incision was made over both eyebrows, and the periosteum was elevated. A somewhat discolored area of softened bone was seen over the front face of the right frontal sinus. It was opened with a curet, and pus was found in the frontal sinus under pressure. The anterior wall and the floor of the frontal sinus were completely removed. The floor was composed of soft bone that could be picked up with a forceps. The posterior wall of the frontal sinus appeared perfectly normal on both sides. A bilateral ethmoidectomy and a bilateral Caldwell-Luc operation were done at the same time.

The patient continued to have a high septic temperature. At no time did she complain of headache. After the operation we had several neurologic consultations

at which no evidence of intracranial involvement was found. However, one week after operation, considerable pitting edema of the whole of the scalp became evident, and the temperature rose to 106 F. The patient had no headache, no stiff neck, and was alert. The material taken at operation for culture showed hemolytic streptococci. Dr. Lyons, of the surgical service of the Massachusetts General Hospital, saw the patient and thought it best not to use penicillin. Roentgenograms were taken three times postoperatively.

DR. A. S. MACMILLAN: Following the operation, roentgenograms showed an area of osteomyelitis at the outer corner of the defect just above the middle part of the orbit. Subsequently roentgenograms were taken which showed no sign of osteomyelitis.

DR. J. R. RICE: However, on January 28, sixteen days after admission, the patient had left homonymous hemianopsia, and the right pupil was larger than the left. She showed weakness in the left leg, and slight weakness in the left arm, Babinski's sign and unsustained ankle clonus on the left side. She was still alert. There was pain over the scalp but no real headache. A lumbar puncture showed 34 red blood cells but no white cells; the initial pressure was 270 mm. of mercury; the protein content was 43 Gm. per hundred cubic centimeters. The patient was again taken to the operating room, and after anesthesia had been established with ether, the granulations were removed from the site of the original operation. When the posterior wall of the right frontal sinus was removed, pus poured out of the opening under considerable pressure. A very large extradural abscess, nearly as big as the palm of the hand, was uncovered. It extended back to the occiput. Bone was taken off over this abscess until sound dura was found in all directions. At the posterior part of the scalp a tremendous abscess of the scalp was seen and drained.

The patient had postoperative localized convulsions. The temperature stayed up. Two days after the operation she lapsed into coma and died. A culture of material taken at the second operation showed alpha and beta hemolytic streptococci. I have a specimen of the dura showing the granulations that grew in over the area of the epidural abscess.

DISCUSSION

DR. G. H. POIRIER: There are two points about this case: First one sees from the granulations that all the disease was on the right side and from the roentgenograms that the pathologic process was on the left. The second point is that at the first operation the anterior wall of the frontal sinuses was taken off and the sinuses cleaned out, but that the posterior wall was not removed. We were influenced by the fact that she was a young girl who had no headache and no neurologic signs. Of course, this was a mistake. Had we taken off the posterior wall, we should have have found this before, and the outcome might have been different.

DR. H. P. MOSHER: I did this myself some years ago; then I tried to convince others that when there is necrosis of the anterior wall of the frontal sinus there is always a defect of the posterior wall at the same time. It is not safe in those cases in which there is perforation of the anterior wall not to open the posterior wall. Whether it would have made any difference in this case I don't know. As for an extradural abscess, I used to think that in order to explain symptoms of increased pressure or indications of pressure the first thing to consider was an abscess of the brain, but later I came to the conclusion that a good sized extradural abscess can produce the same symptoms. I have been astonished how large an extradural abscess can be.

DR. G. B. FRED: I agree with what has been said. The only possible change I should have made would have been to remove the posterior wall.

DR. H. P. MOSHER: How high did the edema go?

DR. G. H. POIRIER: One-fourth inch below the hairline.

DR. H. P. MOSHER: It is a simple thing, really, to uncover the frontal lobe—in other words, to do the radical operation for osteomyelitis. One does not have to worry so much about the deformity nowadays. It is easy for me to talk about it, but it would not have done any harm to take off the whole front wall. And now that we have abandoned the T incision for the inverted U one sees much less cutaneous scar.

DR. G. L. TOBEY: I agree with Dr. Mosher. As to uncovering the middle fossa, I am thoroughly in favor of that. The patient has thrombophlebitis long before he has gross pathologic changes. You expect this osteomyelitis will spread to the dura primarily by thrombophlebitis. I have preached for years that if there is any question whatever, it is best to uncover the lateral sinus on doing mastoidectomy. The same thought applies here.

Three Cases of Orbital Cellulitis. Presented by DR. H. G. TOBEY, DR. PHILIP MYSEL, DR. A. S. MACMILLAN, roentgenologist, and DR. J. J. BALLENGER, resident. (These cases were reported March 3, 1943.)

DR. J. J. BALLENGER: The 3 cases are reported as a group. The first case is that of an 18 year old youth who entered the Massachusetts Eye and Ear Infirmary with the following history: Two weeks before admission he had a transitory headache. Five days before admission the headache returned in the left frontal region and became progressively worse.

On admission he presented edema of both the upper and the lower lid of the left eye, chemosis and almost complete limitation of lateral motion of the eye, diplopia on looking to the left and a considerable degree of proptosis. The left nostril discharged a large amount of pus.

DR. A. S. MACMILLAN: The roentgen films show pansinusitis on the left side with pus in the frontal sinuses and the maxillary sinuses. The cell partitions of the ethmoid bone are decalcified. There is a fluid level in the left maxillary antrum. The remaining sinuses are clear.

DR. J. J. BALLENGER: The patient has been given the following treatment: Hot compresses were applied to the left eye; the nose was sprayed with 0.5 per cent solution of cocaine hydrochloride every two hours. Sulfadiazine was administered until a blood level of 10 mg. per hundred cubic centimeters was obtained. Bacteriologic examination of the nasal discharge revealed a beta hemolytic streptococci. He did not show any improvement after three days in the hospital. A diagnosis of orbital abscess was made, and Dr. Mysel incised and drained the orbit. About 15 cc. of pus was obtained; drains were inserted in the abscess cavity.

The second case is that of a man 40 years of age with the following history: Five days before admission to the Massachusetts Eye and Ear Infirmary he contracted an infection of the upper respiratory tract. Four days before admission the left eyelids became inflamed. Three

days before admission the eyelids became edematous, and the patient complained of frontal headache. The temperature ranged up to 104 F., and the patient felt chilly but denied that he had any true rigor. On admission he presented marked edema of the upper and lower lids of the left eye with chemosis. There was partial fixation of the globe, perhaps not as marked as in the first case, but he also had proptosis. He had no purulent secretion in his nose. The bacteriologic culture showed Haemophilus influenzae.

DR. A. S. MACMILLAN: Roentgenograms reveal acute ethmoiditis on the left side, with increased density of the left orbit. The frontal sinus is perfectly normal. The diagnosis is acute ethmoiditis.

DR. J. J. BALLENGER: Exactly the same treatment was instituted in this case as in the one just presented. On this treatment, the edema of the eyelids has decreased considerably, and the patient is making satisfactory progress.

The third case is that of a boy aged 6 who entered the Massachusetts Eye and Ear Infirmary with the following history: Two weeks before admission his eyelids on the right side became swollen. This was preceded by a slight infection of the upper respiratory tract. Four days before admission the swelling of the lids became much worse, and a severe frontal headache developed on the right side. On admission the right eye presented a livid swollen upper lid; the palpebral fissure was obliterated. There was no proptosis, chemosis or fixation. There was no pus in the nostril. Bacteriologic cultures of material from the nose showed alpha streptococci.

DR. A. S. MACMILLAN: Roentgenograms reveal bilateral sinusitis, with pus in both the ethmoid labyrinths and the maxillary antrums.

DR. J. J. BALLENGER: The treatment has been as follows: Hot compresses were applied to the eye; the nose was sprayed with a 1 per cent solution of ephedrine sulfate three times daily; sulfadiazine was administered until the blood level reached 6.13 mg. per hundred cubic centimeters. The patient showed marked improvement for the following six days. The edema subsided greatly. However, just above the upper lid there is a small area which is tense and fluctuant. This swelling has increased slightly during the past twenty-four hours.

DR. PHILIP MYSEL: We have observed orbital cellulitis in 5 children during the past month, in all of whom it cleared up under conservative treatment. Most of these patients presented marked edema of the eyelids. They did not, however, have chemosis or fixation of the globe. Dr. Poirier points out that there is no reason to explore the orbit unless there is definite evidence of an orbital abscess.

DR. G. L. TOBEY: I think there is a tendency to be altogether too conservative in such cases. Why should one give up surgical treatment simply because one has chemotherapy? For years patients have recovered under surgical management. I cannot see why drainage of the orbit should be postponed when there is clinical evidence of pus and diseased bone.

DR. M. H. LURIE: I have always believed that in such cases there is less danger in waiting than in early operation. Dr. Tobey means to say that if pus appears in the orbit it should be drained. I agree that one should not depend on chemotherapy to cure any condition where there is frank pus. Once an orbital abscess has been diagnosed it should be drained.

DR. L. A. SCHALL: Ninety-eight per cent of such children got well before chemotherapy and without surgical intervention if there was just edema and not pus. The problem resolves itself simply to the question whether there is frank pus or cellulitis. I am happy to see that surgeons are evaluating the patient's condition and not rushing in to operate by hard and fast rules.

DR. M. H. LURIE: I still think that exophthalmos and fixation evidence frank pus in the orbit.

DR. P. E. MELTZER: Do the gentlemen believe that in many of the orbits that show fixation of the globe there is a small amount of pus that might be absorbed? (The answer was yes.)

DR. PHILIP MYSEL: Why is not that a good argument for being conservative in these cases? Dr. Poirier says there can be pus in the orbit outside the capsule without danger to the eye itself, and such patients seem to do well under conservative treatment.

DR. G. H. POIRIER: I should like to make my point somewhat clearer. Whenever there is pus in the orbit, I want to have it drained. I agree with Dr. Mysel that the orbital contents can be swollen without damage to the eye or the optic nerve.

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OTOLARYNGOLOGY, AND THE PHILADELPHIA LARYNGOLOGICAL SOCIETY

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Regular Meeting, Feb. 16, 1944

Symposium on the Rehabilitation of the Deaf and the Hard of Hearing: The Civilian Point of View. Presented by DR. FLETCHER D. WOODWARD (by invitation).

It is a great honor to be invited to speak before this society, and I appreciate the privilege and thank you for the opportunity.

Philadelphia has always been the favorite place to come to observe the best of medical work and to obtain stimulation, both mental and spiritual.

Today with a better understanding of the many factors predisposing to aural disease, both intrinsic and extrinsic, with a better knowledge of the anatomic changes causing deafness and with the development of improved and cheaper hearing aids, otologists are making greater strides. Whereas war is a terribly destructive thing, it has nevertheless speeded up research, the results of which will in the end partly compensate for the destruction.

In addition to the familiar problems of deafness in school children, otosclerosis and the perceptive types of deafness in later years, otologists are today facing a great increase in deafness in young adults, not only in the armed forces but in industry as well, and otologists are responsible for the care of those who have become deaf, as well as for the development of the methods of prevention. The Committee on the Rehabilitation of the Hard of Hearing of the American Academy of

Ophthalmology and Otolaryngology, in preparing a manual to guide a state committee in each state, is organizing the facilities of the states for taking care of rehabilitation, and the help and advice of the individual otologist will soon be requested in this matter.

Industry itself is cognizant of the value of the prevention of deafness and has already in many instances done much to alleviate trauma of the ear from noise by redesigning machines and factories, soundproofing, and furnishing various types of ear protectors.

First, I believe that a survey of the state must be made to establish the approximate number of deafened children and adults now present; then estimates must be made of the number of deafened soldiers and sailors one may expect after the war.

Second, what facilities are there, and how can they be expanded to care for this increasing number of deafened people?

Briefly, among the many things to be considered in this program are: the number of otologists and trained technicians available and willing to carry out wholesale hearing tests; the number of hospitals necessary to take care of disease conditions of the ear, nose and throat; the amount of radium and high voltage roentgen ray units available for treatment.

How many audiometers will there be in each testing center? What type of form and filing system will be used, and how will secretarial and stenographic assistants be paid?

What college departments of education, psychiatry and psychology will take care of the training of teachers in lip reading, correction of speech defects and vocational training?

Cooperation must be obtained from public health doctors and nurses, school boards and parent-teacher associations, as well as the hard of hearing societies and established schools in the state.

The cooperation of industry must be sought, to prevent deafness by correction of existing faults and by furnishing of proper ear protectors.

Perhaps legislation will be necessary; in that case a legislative committee will be required.

Advice as to the types and the fitting of hearing aids must be furnished; perhaps a hearing aid guild should be organized where all makes will be available for testing.

This long list is not to confuse, but to give some idea of the many factors which must be considered in an efficient plan. I should like to emphasize the importance of having a complete plan of organization before any program of rehabilitation is started; otherwise there will be chaos, and otologists will not fulfil their obligation to the civilian population and the returning soldiers. Last of all I should like to solicit the interest and help of the members of this society so that when the Committee of the American Acadamy of Ophthalmology and Otolaryngology finally presents its report, the members will be familiar with its problems and its objectives, and be ready to help in the execution of the plans.

The Army's Plan for Rehabilitation of Deafened Soldiers. Presented by LIEUTENANT COLONEL MARION R. MOBLEY, Medical Corps, Army of the United States (by invitation).

The program had its origin at Walter Reed Hospital, Washington, D. C., following a directive from the Surgeon General's office, designating that hospital as a center for the work with deafened and hard of hearing soldiers. Borden General Hospital, Chickasha, Okla., and Hoff General Hospital, Santa Barbara, Calif., were designated as additional centers. At Walter Reed General Hospital the creation of the service was placed in the hands of Lieutenant Colonel Marion R. Mobley, chief of the eye, ear, nose and throat section, and Captain Edward H. Truex, his assistant.

It is impossible to estimate the number of men in the armed forces who will be in need of rehabilitation because of deafness. Estimates by some of this country's leading otologists run as high as a quarter of a million men. In addition to those with deafness resulting from acoustic trauma from high explosives, there will be thousands admitted to the centers whose deafness existed prior to their military services. The methods of testing that have been used by the Army to determine fitness for military service have done little more than eliminate those with gross hearing defects.

The service at Walter Reed had been in operation only a few months when it became apparent that several thousand deafened persons would be cleared through that institution. This presented an opportunity for the study of deafness never before seen in this country. The original memorandum from the Surgeon General's Office urged us to approach the problem from a research point of view. This gave us the opportunity to develop to the utmost the resources at our disposal, with the primary motive of assisting our patients to overcome their handicap. Armed with the financial backing of the government and the finest electronic equipment available, we set out to secure a personnel for the service with vision and unusual creative ability.

In the past it has been the exceptional otologist who has assumed responsibility for the treatment of chronically deafened patients. In fact, it has been the exceptional otologist whose background of acoustic knowledge fitted him for this undertaking. As a result, patients facing the problems of deafness have drifted to the fields of the social agencies and have been exposed to the exploitation of commercial enterprise. Medical science to date has had very little to offer to them. Some operations have been devised for certain types of deafness, but these have not been universally used, and the number who have been benefited is extremely small. Deafness is a physical abnormality, with definite pathologic aspects, and it is our opinion that the otologist should assume full responsibility for all phases of its treatment. There are few outstanding otologists who are fulfilling that responsibility at present. We cherish the hope that as a result of the accomplishments in these centers for the rehabilitation of deafened soldiers, the otologists of the country will be encouraged at long last to assume their full responsibility for deafened patients. It is also our hope that new tests, methods of examination and additional armamentarium will be devised in these services as a result of our study which can be passed on to the civilian otologists of this country at the termination of the war.

Owing to the rapid growth of the service and the lack of space at Walter Reed Hospital, it soon became necessary to move it from that institution to Deshon General Hospital, Butler, Pa., where facilities were adequate for expansion.

Rehabilitation of the hard of hearing person is a difficult and tedious process. In the eight to ten weeks that a man is kept in the hospital, we can only hope to orient him to his new application, to restore to him as much hearing as possible and to inspire in him a will to continue to learn and to use to advantage all his physical and mental faculties. It requires approxi-

mately eight weeks for a patient to arrive at our center from an overseas assignment. This period is fraught with a great deal of danger to the personality of the soldier who has suddenly lost all or a considerable portion of his hearing. Brochures with appropriate illustrations are being prepared for distribution to all hospital installations overseas. With these we hope to counteract the depressing effect of sudden deafness by assuring the patient that scientific care is awaiting him, just as it is for patients with fractures or other wounds. In fact, we find that the most successful approach to a deafened soldier is a psychologic one. Much of our success in the rehabilitation of our patients lies in our ability to orient them properly to their physical handicap. We plan to associate with us at Deshon one of the country's outstanding psychologists to guide us in this important work. In addition to assisting us to prevent deterioration of personality among our patients, this psychologist will be of great assistance in the creation of suitable intelligence quotient tests to guide us in the proper grouping of the patients from the standpoint of their instructional needs. It is also hoped that he will be able to devise some methods for the evaluation of the instructional work.

General Marshall recently issued a directive specifying the degree of hearing loss at which a soldier shall be admitted to a center of rehabilitation, namely, 30 decibels within the conversational range (256 to 2048 cycles per second) in the better ear, or hearing for whispered voice at 3 feet (91 cm.) or less in the better ear. Where an audiometer is not available, admission is granted in a case of stationary or progressive deafness from acute inflammatory aural disease.

Within two to three days after arrival at Deshon, the patient is studied thoroughly and in turn receives a detailed description of all that we contemplate doing for and with him. Probably his first contact is an interview with the chief or the assistant chief of the service. This interview is one of sympathetic understanding, as we endeavor to impress on him that our sole endeavor is to help him overcome his handicap. Following this, a very painstaking history of his case is obtained, and a thorough physical examination is made, with special emphasis on the ears, nose and throat. Necessary consultations are requested, and a routine examination of visual acuity is made with study of the fields for form and color. Correction of all possible visual defects is completed, for beginning then the patient will be taught to substitute his vision in part for his hearing. Audiometric studies are made in order to determine the degree of hearing impairment. In the near future, we hope to add new tests which will enable us to institute corrective measures more scientifically. The acoustic department of the service will be under the direction of one of the country's leading acoustic physicists. We have also associated with us one of the country's outstanding research organizations. Together we plan an adequate study of the unlimited clinical material on hand in an effort to devise new and improved tests and technics, as well as possible changes in present hearing aids. Our underlying motive will be to place the relief of the hard of hearing person and the fitting of hearing aids on a strictly scientific basis. This will enable us to discard the present trial and error method of fitting aids with all of its objectionable features of inaccuracy and more especially the exploitation by high pressure salesmen.

Following the audiometric study, the molding of individual ear pieces and appointments for further tests, the subject is interviewed by the principal of the school of rehabilitation. She acquaints him with the advantages of lip reading and outlines his course of individual lessons in reading speech, which is supplemented by group practice lessons in lip reading and by the use of "life situation" motion pictures for the teaching of lip reading.

Before beginning his courses, he is given a leave of absence, confident that when he returns, there will be a rich experience in store for him. In the meantime he has been interviewed by the supervisor of rehabilitation, a Red Cross social worker, who has planned with him his social, recreational, vocational and occupational rehabilitation. If there has been a sudden loss of hearing or any marked change in personality in the patient which should be interpreted to his family, she communicates with them prior to his arrival. She prepares them for such changes and urges that his homecoming be as normal as possible, free from any pity or undue sympathy.

On returning from leave he begins his course of instruction. The teachers of lip reading have been chosen not only for their academic qualifications but for their intimate knowledge of the mental processes of the deafened patient. Many of them have suffered from deafness of varying degrees, which they have overcome, and as a result of this background they have become excellent appliers of clinical psychology.

Many of our patients present abnormalities of speech, especially those who have had deafness of long standing. Such abnormalities of speech are prone to develop also in the person who has suddenly lost all or most of his hearing. We have on our staff academically qualified speech correctionists to deal with this aspect of the rehabilitation of the deafened.

The majority of our patients have some degree of residual hearing, and it at once becomes our duty to fit each of them with the most satisfactory hearing aid available, the selection to be made from any of the instruments accepted by the Council on Physical Therapy of the American Medical Association. A directive recently issued by the United States War Department authorizes us to supply a hearing aid to any of our patients whose hearing will be improved by such an instrument, regardless of whether or not the hearing loss occurred as a result of military service. An effort is made to provide the hearing aid as early as possible in the period of rehabilitation in order to increase auditory acuity and thus accelerate progress in lip reading.

Auricular training of residual hearing is extremely essential in the rehabilitation program. These patients need to be trained to use a hearing aid to maximum advantage. To provide this training we have secured the services of one of the country's outstanding teachers to instruct our patients in the proper use of a hearing aid, especially in conjunction with lip reading, in order that they may utilize fully all their powers of comprehension.

Our program contemplates adequate recreational rehabilitation. This aspect of the work is in charge of well trained leaders.

After their period of rehabilitation in the Army has been completed, the majority of our patients are returned to civilian life. As they leave the Army, the Red Cross facilitates their transfer and acquaints them with the various civilian organizations to which they can apply for further rehabilitation. The local Red Cross chapter in the discharged soldier's home town is

communicated with and informed of further rehabilitation measures indicated. These agencies include the Veterans Administration, the various chapters of the American Society for the Hard of Hearing, the Vocational Rehabilitation Bureaus of Social Security, United States Employment Bureaus, rehabilitation agencies of the American Legion and the state committees of civilian otologists, appointed by the Hearing Conservation Committee of the American Academy of Ophthalmology and Otolaryngology.

DISCUSSION

CAPT. EDWARD TRUEX, M. C. (by invitation): Colonel Mobley has given a very complete outline of the program that has been instituted in the Army for rehabilitation of the hard of hearing. My remarks tonight are, for the most part, of a negative character. As this program expands we are coming to regret more and more that the Army during its period of rapid growth chose the voice test to decide whether a man was or was not qualified for duty. Not only is this test no real indication of a man's hearing acuity but, I believe, there were few induction stations where an effort was made to apply the test in a conscientious manner. There is no doubt that many of the otologists here have worked in various induction stations and noted the methods and the ridiculous circumstances under which some tests were made. The Army was in dire need of manpower at that time and had to adopt this or a similar method of testing to screen out those who were obviously unable to perform adequate service. I am aware of various other methods of testing, as are all the members of this society, but being in the Army it is not within my province to speak further on this subject. As the men are released from service because of disability, the government wants to know whether the particular soldier's defect was caused directly by service, or whether it existed before he came into the service, or whether an existing defect was aggravated by service to an extent entitling him to various degrees of compensation. It is one of our jobs at the present time to make the decision on the "line of duty" status of each man's defect before he leaves the hospital. This is by no means an easy task since the records on admission to the service are completely unreliable and the future economic condition of the man may depend in good part on our decision.

Repeatedly induction records have shown normal hearing for a patient who gives a history of defective hearing long before coming into the Army and in some cases gives evidence of having had infected ears. Just a few unreliable records of this character make all induction records of hearing acuity undependable. These men in spite of the findings at induction are considered not to have suffered any injury of the acoustic apparatus in line of duty, and we have been pleased with the naive manner in which the great majority of them expound on the defects that they had before entering service. Perhaps it is through ignorance of the economic consequences that they give out this information, but I believe it is inherent honesty on the part of most of them.

Between October 28 and February 11 a total of 217 men with hearing below minimal Army standards were admitted to our hospital. Minimal standards are based on the whispered voice test, 8/15 or better being required for general service and 5/15 or better in both ears for limited service. If one ear is found to be less than 5/15, the other ear must be 15/15. Of these 217 men, 93, or 42.9 per cent, were considered to have a hearing loss as a direct result of service; 154, or 57.1 per cent, were found to be "Line of duty . . . no," the defect having been present prior to induction, and of these, 28, or 12.9 per cent of the total, were deemed to have lost more of their hearing as a direct result of service.

So we are disappointed in the hearing aid policy that has been adopted. According to existing regulations, we have been permitted to purchase hearing aids at government expense only for those men whose hearing loss has been incurred or aggravated in line of duty. In other words, 121 soldiers to date have been eligible to receive an aid at the government's expense. Every man regardless of his "line of duty" status, provided his hearing level warrants it, has an ear mold made of one or both ears and is given trial fittings of the various Council-accepted instruments. To date, however, we are sorry to have to admit that the dispensation of hearing aids has been on a trial and error basis, the patient being allowed to decide which aid best fits his needs. We are fully aware of this unscientific approach and deplore its necessity. We have noted, of course, the increment of improvement that the aid produces, but we have made no effort to make this increment a part of the selective process. Moreover, we realize that even this would be of little value. As yet the subjective reaction alone has determined the selection of the aid. With adequate equipment under construction, as well as additional personnel, which we hope is essentially on the way, we expect to alter our dispensation policy in the near future and give it some scientific significance. I refer here particularly to speech reception equipment with which we can determine more accurately the serviceable improvement any particular aid will give to an individual patient. In addition we hope to acquire or devise other methods for quantitatively recording the value of any particular aid. Our ultimate aim, which is certainly rather nebulous, is to be able to prescribe one particular aid for a patient without his ever giving it a clinical trial.

We expect soon to have on our staff a man who has the knowledge and the resourcefulnss to control and direct the fitting and testing of all hearing aids and eliminate forever the appearance of salesmen in the hospital. Moreover, in the near future a system will be started wherein each man who has obtained an aid will be asked for a truthful answer to each of certain questions, and it is my impression that the response will prove that a large percentage of the hearing aids that have been fitted by the existing methods are now on the shelf. It will be interesting to see how many of these instruments are out of use in comparison with those that are fitted by more scientific methods at a later date.

DR. GEORGE M. COATES: Both previous speakers gave Philadelphia credit for some of their training. Dr. Truex' father also studied in Philadelphia. The previous Committee on Otolaryngology of the National Research Council did not have much success. It tried to interest the medical department of the armed forces especially in the use of the audiometer and in the development and use of an aid for preventing loss of hearing in combat. The existence of the National Research Council now may be the result of work done toward this end by that committee. In the last war we were allowed to make a diagnosis of malingering only at the Veterans' Bureau, and were told to keep compensation as low as possible. There were cases of exaggeration. The old

method of preventing injury in combat was to stand on the toes and hold the breath, having previously placed cotton in the ears. This may have helped some. Today soldiers cannot do that with the modern rapid fire equipment and for numerous other reasons. Therefore, the Committee on Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology is trying to develop something which may prove helpful along this line. I was much impressed last summer when Colonel Mobley and Captain Truex came to Philadelphia and presented their plan, which is now being tried. It seems that they had an excellent program planned, and we hope to have further reports from them. This will be helpful to those in the Army who have been deafened, particularly those who have a 30 decibel loss or greater. Gordon Berry wrote an article some years ago entitled, "Psychology of Progressive Deafness" (*J. A. M. A.* **101**:1599-1603 [Nov. 18] 1933), which is an excellent article for otologists as well as for those suffering from impaired hearing.

DR. JAMES A. BABBITT: May I in behalf of the Academy express appreciation for the courteous reference to the Academy in this great piece of work for conservation of hearing and may I also express appreciation in noting the so apparent harmonious cooperation of the two departments which are represented here? This has been a forceful presentation, broad in its concept and scientific in its character.

I cannot help taking some slight exception to Dr. Woodward's plan for further survey in his state. While such a plan may be necessary in Virginia, there have been too much general time and effort spent in surveys throughout the country, on this problem, and I do not think more information of value will be obtained. I am also glad to note that representatives from the Army are expressing themselves freely as to the whisper and spoken voice test in the determination of perceptive deafness, which can scarcely be amenable to any form of routine treatment unless there are obvious foci of infection or defects of anatomy and function in the otorhinopharyngeal tract. In this type of deafness one is practically reduced to lip reading or artificial hearing aids. This reduces the problem to a consideration of the prevention of this deafness in children of preschool age and early school age, in the hazard of civilian manufacture and on the battle front. Everywhere people are discussing the great problem of the appropriate type of silencer or guards to prevent the effects of concussion or explosion on the hearing mechanism. Dr. Marshall Taylor, of Jacksonville, Fla., who has done so much in the prevention of sinusitis during his studies on the swimming pool and on obstruction of hearing through prenatal administration of drugs, asked me to bespeak the cooperation of those clever dentists who work with rubber and casts and who are perhaps better qualified to do this work than specialists in the otolaryngologic field. I can only bespeak an earnest share in the investigation of this phase of prevention in the service represented by Colonel Mobley and Captain Truex.

The Academy has changed the title of its special hearing committee from the "committee on amelioration of deafness" to the "committee on conservation of hearing," to which may be appropriately added "and economic rehabilitation."

It has been of inestimable value to have presented this vivid picture of the great work which is being done in this field.

DR. WALTER HUGHSON †: There are several phases of this important problem that Dr. Woodward, Colonel Mobley and Captain Truex have touched on that I should like to discuss in a more or less general manner. War deafness belongs definitely in the casualty class. Immediate rehabilitory efforts belong properly to the Medical Corps of the Army and the Navy and to the Veterans' Bureau. But, as Dr. Woodward has brought out, many of these men will return to civilian life, and their problem then will be one for civilian otologists to help control. This the American Academy has anticipated and is setting up state committees and clinics.

It is highly gratifying to hear of the intelligent planning and the prompt inauguration of the program set up by the Surgeon General's office. Colonel Mobley's deafness center at the Deshon Hospital in Butler, Pa., is functioning in a most admirable manner, and the aural casualties already received are being given every type of modern aid available.

I was pleased to learn that a loss of 30 decibels in the better ear is now the standard for qualification to enter the rehabilitation program. Grave injustice would have been done to many men if the original standard of a 60 decibel loss in the better ear had been adhered to. Colonel Mobley stresses the importance of psychologic help for these returned service men. This is, of course, a matter of the greatest possible moment in the over-all solution of each individual patient's problem. I hope that Colonel Mobley will be able to carry out his ideas to the fullest extent.

In any discussion of this kind, the immediate question arises, how many of these casualties will present themselves for final handling? According to a recent report, a random group of foot soldiers who had been exposed to high explosive blasts were examined, and 60 per cent were found to have a hearing loss. That the final number will be large goes without saying.

One rather disquieting point was mentioned. Observations have been made that servicemen with a prewar loss seem more susceptible to the hazards to hearing of this war than men with normal hearing. Is the campaign to have deaf civilians enter war industries a valid one? Otologists have felt that deafness was a protection against the effect of acoustic trauma. If this is not the case, they may expect a great increase in the number of civilian casualties of the war.

The Army's policy in regard to supplying hearing aids is a splendid feature of their program, provided the aids are fitted in a proper technical manner. Colonel Mobley is, I believe, shortly to have complete facilities for such fitting.

Colonel Mobley and Captain Truex are to be congratulated on the way in which they have inaugurated the program of the Surgeon General of the Army for the rehabilitation of the aural casualties of this war.

DR. HAROLD WESTLAKE: The idea I am going to express is not a new one. I have written it repeatedly in letters to Lieutenant Colonel Mobley, to Major Barton and to others with whom I have had correspondence regarding the problems of rehabilitation. Furthermore, it is an idea with which both Lieutenant Colonel Mobley and Major Barton have genuine sympathy, even though they have not been able to do too much about it in a practical way, because personnel has not been available.

The history of the development of certain branches of medicine is a history of wars, because the war

† Dr. Hughson died Sept. 13, 1944.

casualties furnished quantities of exceptional human material for study. As Lieutenant Colonel Mobley stated, this war is furnishing a large pool of deafened adults. It is to the best interest not only of medical men but of all persons, both military and civilian, that this pool of aural casualties be studied and the findings reported.

Many of you recall that at the close of World War I a group of deafened soldiers was given instruction in lip reading at Cape May, N. J., as a rehabilitation project. Without being critical of that work in any way, one may honestly say that it contributed little to present knowledge of the deafened. The reports which came out after the project had been completed testified that a sincere effort had been made to help the acoustically handicapped soldier and that this effort had been largely successful, but as far as furnishing objective data which will help otologists today to meet the problems of rehabilitation, the Cape May project has been of little use. This may be largely explained by the fact that certain research technics and research interests have been developed since that time. It will be a deplorable thing if no scientific study is made of the aural casualties of World War II.

There are many things otologists do not know about deafened persons. They do not know what qualities in people contribute to success in lip reading. They do not know what procedures are best in the instruction of the deaf in lip reading. People seem to develop skill in lip reading through different instructional methods, some of which have basic hypotheses that are absolutely not tenable. They do not know how long hearing impairments can be sustained before the speech begins to show degenerative changes. They have little specific knowledge on the changes in personality which result from impaired hearing. They are not sure how effective auricular training can be in improving a deaf person's efficiency with a hearing aid.

These are only some of the problems to which otologists must apply research technics. Nothing useful can be gained from relying entirely on the subjective analysis of a teacher, no matter how skilful that teacher may be as an instructor. The situation demands the skill of a trained psychologist or another worker who has undergone good research discipline.

The statement was made that various rehabilitation aids are using psychology. The term "psychology" is bandied about considerably. People do not practice medicine until they have a medical degree and have passed a state board examination, yet every one presumes to practice psychology, and probably does practice it from the lay point of view. However, that should not obscure the fact that there is a group of trained psychologists who have come through a strict academic discipline. They are prepared with research technics to organize objective data in an effort to solve the important problems listed in these reports. The lay usage of the term "psychology" should not be allowed to confuse otologists so that they think that the specialistic services are already used.

A statement was made to the effect that every short cut must be made so that something actually is done for the war casualties, and that of course is true. It would be short sighted to displace any of the important services which Colonel Mobley has outlined in favor of a purely research project. At the same time otologists cannot, in justice to all deafened persons, civilian and military, ignore the high professional charge to further knowledge of deafness and of the social, psychologic and economic changes which come as a result of it.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

SAMUEL J. PERLMAN, M.D., *President*

WALTER H. THEOBALD, M.D., *Secretary*

Regular Monthly Meeting, March 6, 1944

(The scientific program was presented by the department of otolaryngology of the University of Illinois.)

Histopathology of the Nasal Mucosa of Older Persons. Presented by DR. A. R. HOLLENDER.

This article was published in full in the ARCHIVES OF OTOLARYNGOLOGY (**40**:92 [Aug.] 1944).

Post-Thyroidectomy Bilateral Laryngeal Paralysis Complicated by Myxedema and Hypoparathyroidism. Presented by PAUL H. HOLINGER.

Increased interest in the problem of bilateral paralysis of the vocal cords associated with thyroidectomy may be accredited to the operation devised by King. Proper restoration of function is primarily a surgical problem. However, medical aspects of the problem require more attention than is generally directed toward them, and in many instances may be responsible for the success or the failure of the surgical procedure.

The accidental section of both recurrent laryngeal nerves in itself usually indicates that an extensive operative procedure has been done. Consequently, one may expect to find associated with bilateral paralysis following thyroidectomy varying degrees of myxedema and hypoparathyroidism. This possibility has been shown to occur in each of 6 patients recently referred for relief of the respiratory obstruction associated with their bilateral paralysis. Medical examination in each showed varying degrees of myxedema as evidenced by thick skin, low voltage electrocardiogram, high serum cholesterol, anemia and mental sluggishness or depression. The determination of the basal metabolic rate was considered erroneous because of leaks around the tracheotomy tube, if the patient was tracheotomized, and because of the chronic anoxemia if the patient was not tracheotomized. That parathyroid tetany was present in each was evident in the history of cramps in the hands and the feet, in psychoses and in the laboratory proof of extremely low blood calcium and high blood phosphorus.

For the thyroid deficiency thyroid substance was administered, the treatment being controlled by the clinical course and the studies of the blood rather than by determinations of the basal metabolic rate. For the parathyroid deficiency calcium lactate or gluconate and vitamin D or di-hydrotachysterol was administered, this therapy being controlled by studies of the blood calcium. In 2 of the patients operated on by lateral transposition of the arytenoid, symptoms of obstruction recurred six months and one year later. These patients were found to have discontinued the use of thyroid extract and calcium. Improvement followed return of the chemical constituents of their blood to normal levels. Because of these observations it is felt that the association of myxedema and tetany with bilateral paralysis of the vocal cords due to involvement of the recurrent laryngeal nerves is fairly frequent and that best surgical results can be obtained only after correction of endocrine deficiencies.

Hereditary Hemorrhagic Telangiectasia. Presented by DR. MAX H. CUTLER.

A 54 year old white man with hereditary hemorrhagic telangiectasis and a history of severe exsanguinating epistaxis required during a period of four years a total of fifty-four blood transfusions. Control of bleeding was established by a balloon catheter, which allowed discovery and ligation of a large arterial bleeding point. The patient has been relatively free from epistaxis since this was done.

Three groups of cases are differentiated from the point of view of symptomatology:

1. Cases with telangiectasis in evidence but with no bleeding. The patients are usually discovered in a survey of families in which other members have severe bleeding, and usually they do not come for aid.

2. Cases with mild to moderate degrees of epistaxis, which can be controlled by local measures, such as cautery and cotton packs. The condition is self limiting and does well with liquid petrolatum for crusts and radium therapy.

3. Cases with severe exsanguinating epistaxis, in which a traumatic background, surgical or otherwise, may be present. In this group there is a mortality rate of 4 per cent. This type of epistaxis usually occurs in the age group from 45 to 60, when vascular changes are of greater occurrence. There is erosion by the telangiectasia of large or major arterial twigs. The patients require repeated transfusions, through which intolerance may develop. Treatment with radium alleviates the condition in some cases, while in other cases it is of no value.

Carcinoma of the Maxillary Sinus. Presented by DR. MAURICE F. SNITMAN.

The early treatment of carcinoma of the maxillary sinus was entirely surgical, but results were uniformly bad, since the lesions were well advanced when first seen. With the event of roentgen ray and radium therapy, more encouraging results were obtained by a combination of surgical treatment and irradiation. The type of irradiation was usually that obtained by implantation of radium in the operative field. Since 1931, protracted fractionated irradiation combined with limited surgical treatment of the antrum for purposes of drainage and inspection has led to a substantial improvement in results. Del Regato in 1937 reported five to fifteen year cures in 4 of 10 patients with carcinoma (del Regato, J. A.: Roentgenotherapy in Epitheliomas of Maxillary Sinus, *Surg., Gynec. & Obst.* **65**:657-665 [Nov.] 1937). Dr. Danely P. Slaughter, director of the tumor clinic of the University of Illinois, suggested the supplemental application of intracavitary radium, and this procedure was followed in 2 recent cases.

CASE 1.—A. R., a white woman aged 42, was first seen on April 3, 1943, with a complaint of expectoration of bright red blood in the morning for four weeks and swelling of the left malar region for six weeks. There was a history of numbness of the left side of the face in 1937, associated with postnasal discharge and frequent occurrence of sore throat. Gradually severe headaches set in, which persisted for one year; there were frequent infections of the upper respiratory tract. All upper teeth were removed in 1942. In February 1943, in conjunction with a severe infection of the upper respiratory tract with nasal obstruction, there were expectoration of blood and slight redness of the left eye, with a sensation of "crawling" over the left cheek. For a year prior to the first examination she had occasionally noted blood-tinged mucus on expectoration.

On examination there was distinct swelling over the left cheek below and lateral to the eye; there was some limitation of lateral movement of the left eye. On transillumination the left antrum was dark; on irrigation there were no significant findings. A roentgenogram showed increased density over the left antrum with a distinctive change in the malar bone suggestive of tumor formation.

On April 28, 1943, a Caldwell-Luc operation disclosed a mass filling the antrum, and biopsy of this mass showed cylindric cell carcinoma. A total of 4,800 roentgens (r) was given to two portals over the left antrum and temple between May 24 and June 26. On July 1, 1943, with the patient under general anesthesia, the external carotid artery was ligated, and the antrum was reopened with removal of the greater part of the canine wall and alveolar process. Several weeks later a small fluctuating swelling, about 1.5 cm. in diameter, developed over the outer angle of the left orbit. This disappeared following insertion of two radon seeds of 1.5 millicuries each. On July 30 the antral cavity was given 1,500 millicurie hours of radium. There was uneventful healing with a permanent antral fistula. Examination in February 1944 showed a smooth-lined cavity, which has shown the same appearance for the past several months.

CASE 2.—F. W. H., a 67 year old man, was first seen in October 1943, with a complaint of swelling of the right cheek, chiefly in the malar region, and narrowing of the palpebral fissure; in addition, there was a large swelling of the right upper cervical node, as well as a smaller swelling of one in the lower part of the posterior triangle. Fourteen months before, the patient noted itching, burning and smarting over the right cheek; the swelling was not apparent until about one month prior to consultation in October. He had lost 10 pounds (4.5 Kg.) in the past few months.

Examination of the nose and the mouth showed nothing abnormal. Roentgenograms showed involvement of the malar bone and of the floor of the orbit. The antrum was cloudy, and the nodes in the upper cervical region and the posterior triangle were seen.

On October 25, with the patient under general intratracheal anesthesia, the right external carotid artery was ligated and the right antrum opened sublabially. The cavity of the antrum was filled with friable degenerated tissue; this was cleaned out and the anterolateral surface of the antrum was removed. Seven radium needles of 10 mg. each were arranged in a circle in the antral cavity and left in place for twenty-eight and one-half hours, giving a total dose of 2,000 milligram hours. In the upper cervical node 13 radon seeds were implanted directly through the skin for a total dose of 2,600 millicurie hours. The lower node received 4 radon seeds (800 millicurie hours) and disappeared within eight days. On November 10, 7 more radon seeds (1,350 millicurie hours) were implanted in the upper node, and ten days later epidermitis developed in this area. From November 3 to December 13 the patient received daily treatment with external radiation, which was directed to the antrum through two portals until a total dose of 5,260 r was given. Another series of daily treatments from December 18 to January 12 totaled 3,800 r.

Examination in the latter part of February 1944 disclosed that a fibrotic nodule had replaced the large

upper cervical node. The antral fistula permitted free inspection of the cavity, which showed a fair degree of radionecrosis.

The immediate result has been quite satisfactory in each of the 2 cases. Obviously, more time and a larger series will be necessary for the determination of the efficacy of intracavitary radium supplemental to protracted fractionated treatment with external radiation and limited surgical treatment.

Disease of the Sphenoid Sinus. Presented by DR. O. E. VAN ALYEA.

Inflammatory conditions involving the sphenoid sinus appear far more often than is generally supposed. Many exist unrecognized, the diagnosis being finally made at the autopsy table. A high rate of incidence, 13 per cent as determined by anatomic study and as observed at autopsy, would indicate that many are of low grade type with minor symptoms. In this group undoubtedly falls the complex of mild postnasal drip, chronic irritative cough and periodic attacks of husky voice. The mucosa of the sinus is functioning, but some interference with drainage prevents a spontaneous cure.

Factors which in the presence of an infection may cause impairment of drainage are anatomic and pathologic.

The anatomic factors are: (1) a small ostium, 2 mm. or less in diameter; (2) an ostium near the roof; (3) a shallow sphenoethmoid recess, which permits blockage of heavy secretions; (4) a deviated septum which impairs ventilation of the sinus and narrows drainage space; (5) presence of recesses, partial septums and spurs in the sinus walls.

The pathologic factors are: (1) allergy with or without polyp formation; (2) thickened inflammatory mucosa, which narrows the lumen of the ostium; (3) hyperplastic tissue, benign or malignant, encroaching on the ostium.

Symptoms credited to infections of the sphenoid sinus are so multitudinous and variable that they are of little value in diagnosis. A satisfactory roentgen study is desirable. This includes the use of contrast mediums and a variety of views, the most important of which is the submental vertex projection. Proper investigation also includes mirror examination of the postnasal space. The presence of thick tenacious secretions or crusts in the oropharynx or the nasopharynx, or on the anterior face of the sinus, as seen by anterior rhinoscopy, are strong indications of the presence of chronic sphenoiditis. Irrigation of the sinus supersedes all other diagnostic measures in revealing the presence and the nature of the infectious process.

Three clinical types of sphenoiditis are observed: acute sphenoiditis, acute exacerbation of a chronic infection and chronic sphenoiditis. Several cases are cited as examples of the various types of infection which involve the sphenoid sinus and to illustrate (1) the importance of a consideration of the sphenoid sinus in all cases of pansinusitis, (2) the severity of symptoms in an acute attack and (3) the value of early drainage of blocked cavities in the presence of severe symptoms.

DISCUSSION

DR. HOWARD C. BALLENGER: Dr. Snitman mentioned paresthesia as a prominent symptom in 2 cases of carcinoma of the maxillary sinus. In the first instance the tumor was in the upper wall of the sinus. I should like to know if the growth originated in the roof of the maxillary sinus in the second instance as well. Paresthesia and anesthesia of the side of the face seem to be early symptoms of malignant growths originating in the upper half of the maxillary sinus. This point needs stressing as an important diagnostic symptom.

DR. ALFRED LEWY: I should like to report a case of disease of the sphenoid sinus in which the diagnosis was missed. The patient was a middle-aged woman who had undergone some mental changes. She had right-sided otitis media of unknown duration, with nystagmus to the left and vomiting. A diagnosis of right suppurative labyrinthitis was made. Operation was refused. Meningitis soon developed, and the patient died. Autopsy showed the meninges in the region of the right temporal bone to be perfectly normal. The meningitis was practically limited to the left side. The source was found in the necrotic roof of the left sphenoid sinus, which led to the infected sphenoid cavity.

DR. THOMAS C. GALLOWAY: We have had quite a few patients with Osler's disease at the Cook County Hospital, but have not been able to do much for them. One was a physician who had been to many clinics but had increasingly severe hemorrhages. We have treated some of the bleeding lesions with desiccating diathermy, but I have not seen much result from radium or radon, and in most cases the condition seems to go on a downhill course. One of our residents (Frank J. Piszkiewicz) found one family in which 7 or 8 members had the disease.

With reference to carcinoma of the antrum, in the presentation of individual cases it is easy to show some beautiful results—and these results are beautiful—of a few months' duration. However, one should be interested in five year cures. There have been at least three important series of patients given surgical treatment—usually electrocoagulation—combined with irradiation, with roughly 37 per cent cures, and the combined method would still seem to be the best.

In those cases in which external symptoms are produced my experience has been that destruction of the invaded bone by surgical diathermy is required.

DR. SAMUEL SALINGER: I should like to point out, in connection with carcinoma of the antrum, that the Mayo report makes a sharp distinction between carcinoma involving the lower half of the antrum and that which takes in the upper half, showing a definitely better prognosis in the former. I agree that judging by the results reported in these large series of cases the best results have been obtained by surgical diathermy followed by irradiation.

I was impressed by the frequent mention of the use of contrast mediums for diagnosis. I have been a strong believer in this procedure and advocate its use whenever possible, particularly in doubtful cases or those in which surgical intervention is contemplated.

The sphenoid sinus, because of its remoteness, has too often been neglected. There has been a high incidence of intracranial complications traceable to involvement of the sphenoid sinus, frequently overlooked. The report by Pickworth and Graves in connection with a study of the relationship between sinus disease and mental disorders mentions the investigation of tissue removed from the sinus. In numerous instances they found attenuated streptococci deep in the mucosa and even in the bony lacunas. I think if one looks for disease of the sphenoid sinus more frequently one will find it.

DR. HANS BRUNNER: Dr. Hollender's presentation exhibited genuine disease of the nasal mucosa. Too frequently pathologic changes of the nasal mucosa are described to fit the personal interpretation of the author. The pathologic character of the hyaline deposits which

were demonstrated cannot be doubted, and on the basis of these deposits this study possesses considerable merit. The practical conclusions which can be drawn from this investigation may eventually prove valuable.

Dr. Holinger's paper was interesting. It proves that in instances of bilateral abductor paralysis following operation for goiter, the surgical repair of the nerve function does not solve the entire problem. If his observations are confirmed by further observations, one must assume that the paramedian position of the vocal cords following injuries of the laryngeal recurrent nerves, is due not only to the surgical lesion of the nerves but also to laryngospasm which, in turn, is due to damage of the parathyroid glands. The latter part of this concept is supported by many endocrinologists, who believe that laryngospasm in children as well as in adults is, as a rule, attributable to hypofunction of the parathyroid glands even if there are no other symptoms or tetany.

Dr. Cutler, of course, does not consider his patient as definitely cured. Osler's disease is a systemic disease which involves the walls of the capillaries, and though the hemorrhage is stopped in one place, it may occur in another place at any time.

Dr. Snitman mentioned the poor results obtained in the past by surgical treatment of antral carcinoma. In those days intratracheal anesthesia was not employed. Furthermore, patients were usually operated on by general surgeons, who made a complete resection of the maxilla. In many instances death was due to pneumonia. At present the prognosis is better. Nevertheless, it depends much on the structure of the tumor and on whether there is involvement of the ethmoid cells. So far as the glands are concerned, one must keep in mind that enlargement of the glands is not always due to malignant growth. Frequently the enlargement is caused by inflammation, in which case the glands may contain tubercle-like formations.

DR. M. F. SNITMAN: Both these patients showed involvement of the malar bone and had almost similar complaints of itching and crawling sensations over the face.

Enlarged cervical nodes may certainly be tuberculous, but in all cases treatment by implantation of radon seeds is preceded by an aspiration biopsy proving the presence of a malignant growth. Dr. Galloway should be complimented for the statement he made in a recent article in the *Annals of Surgery*, emphasizing the need for teamwork in the management of malignant neoplasms.

These are both very recent cases and are presented as showing the immediate results when fractionated protracted treatment with external radiation is supplemented by limited surgical exposure of the antrum and intracavitary use of radium. If one can secure the advantages of protracted irradiation in the management of carcinoma of the antrum, as one can with cancer in other regions, one may obtain an increasing rate of cures. It is interesting to note that Watson of the Memorial Hospital for the Study of Cancer and Allied Diseases reports that every patient cured in the past seven years has had roentgenotherapy, and in 6 instances this was the only treatment employed.

Regarding invasion of bone, Willis, in his text "The Spread of Tumors in the Human Body," states that carcinoma involves bone after the latter has undergone inflammatory changes as a result of infection.

News and Comment

DIRECTORY OF MEDICAL SPECIALISTS CERTIFIED BY AMERICAN BOARDS 1945. PUBLISHED BY THE ADVISORY BOARD FOR MEDICAL SPECIALTIES

The biographic data of the first two editions of the "Directory of Medical Specialists" included only positions (internships, residencies or assistantships) held during the course of training of men up to the time of their certification by the American Boards, and positions on hospital and medical school staffs then currently held.

It is desired to extend these data in the third edition to include all formal appointments to hospitals and medical schools, with dates for which they were held, even though the appointee has now resigned, as well as records of all military service, including commissions and dates, whether in World War I, in the reserve forces in peacetime or in the present war.

Thus, a chronologically complete sketch of the entire career of a certified specialist is to be included in this third edition of the "Directory."

Membership or fellowship in national or sectional (not local) special societies and national general societies, with offices held and dates, should be reported.

Membership in recognized international medical societies may be included, but honorary or other membership in foreign medical societies should not be reported.

The certificate may refer to the second edition (1942) of the "Directory" for lists of medical societies to be included in his biographic sketch.

Families or secretaries of men absent in military service are asked to complete or correct previous listings or to prepare new forms now being mailed to physicians eligible for inclusion in the "Directory." Only persons certified by an official American Board can be included, and there is no charge for this listing.

This notice is published in response to many inquiries to assist physicians certified by the American Boards who are now engaged in correcting their previous listings or in preparing new sketches for the third edition of the "Directory," to be published early in 1945.

Communications should be addressed to the Directory of Medical Specialists, 919 North Michigan Avenue, Chicago 11.

American Board of Otolaryngology.—Examinations will be conducted on June 5-8, 1945, at the Hotel Waldorf-Astoria in New York, and on Oct. 3-6, 1945, at the Palmer House in Chicago.

Book Reviews

The Art of Anaesthesia. By Paluel J. Flagg, M.D., visiting anesthetist to the Manhattan Eye and Ear Hospital; consulting anesthetist to St. Vincent's Hospital, New York; chairman of the Committee on Asphyxia of the American Medical Association. Seventh edition. Pp. 519, with 166 illustrations. Price $6. Philadelphia: J. B. Lippincott Company, 1944.

Student and teacher of what he likes to call "pneumatology" these many years, Dr. Flagg has earned the respect and confidence of his profession. The mettle of the man is measured in his dedication: "To I. H. S. My Dearest Master." His approach, therefore, is that of an extremely conscientious protagonist who has at heart only the greatest good to the greatest number. To lose a patient on the table is to him one of the greatest calamities which can befall any doctor. He realizes that the "gas giver" has an even greater responsibility than the surgeon; therefore, Flagg is all for safety. While describing in full the "newer methods," with such agents as pentothal sodium and tribromoethanol, he feels that the nitrous oxide–oxygen–ether sequence is still the method of choice in most cases. The range of knowledge which an anesthetist must have to be at his best comprises a familiarity with such factors as the nature and the control of war gases, the problems of high flying and of submarine escape, the effect of compressed air in caissons and the treatment of carbon monoxide poisoning. This breadth of view has led the author into the highways and byways of "Resuscitation" and to the formation of a Society for the Prevention of Asphyxial Death (S. P. A. D.) of which he is founder and president. In fact a special volume bearing this title will be issued shortly from the press. Part I of the present book deals with the classification of anesthesia and with its induction and maintenance by various methods. Part II bears on factors incidental to actual administration of anesthetics. In this section, new agents and methods are described in detail.

Dr. Rudolph Matas has written for this seventh edition an excellent foreword which is in itself a competent review of the book and of the qualifications of its author. It is the opinion of this reviewer that Flagg's book will go through as many editions as Osler's. The reason is obvious.

Speech Reading—Jena Method. A Textbook with Lesson Plans in Full Development for Hard-of-Hearing Adults and Discussion of Adaptations for Deaf and Hard-of-Hearing Children. By Miss Anna M. Bunger, instructor of speech reading, Department of Special Education, Michigan State Normal College, Ypsilanti, Mich. Pp. 136. Price $2.50. Danville, Ill.: The Interstate Printers and Publishers, 1944.

Many years ago, the late Dr. Karl Brauckmann of Jena, Germany, developed a method of teaching the deaf to read by emphasizing syllabication in feet and in phrases. This is important in teaching spelling and an understanding of reading for pleasure even to "normal" children. Dr. Brauckmann's work was taken up by Miss Bessie L. Whitaker and Miss Anna M. Bunger at the Michigan State Normal College. Those of us who think we are "good speech readers" should inspect the twenty-six qualifications set down on page 18 of this book. Enunciation so perfect that one can read lips without hearing sound is a rare gift; in fact, it is scarcely a gift at all but must be cultivated. In these days even deaf-mutes are being taught to read and speak, thanks to the tireless efforts of a few devoted teachers whose patience and skill are extraordinary. This is not for the doctor of medicine, but he ought to know about it and guide those who come to him for advice and direction.

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